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[OFFICIAL NOTICE.]

Instituting "Wrinkle" and "Novelty Advertising" Departments, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF THE SECRETARY,
DELAWARE, O., Dec. 7, 1900.

For the seventeenth annual meeting of the Ohio Gas Light Association, which is to be held in Dayton, O., March 20th and 21st, 1901, the Executive Committee has created two new features, viz.: A Wrinkle department, for which Mr. Henry L. Doherty, President Denver Gas and Electric Company, Denver, Col., has been named as Editor; and a Novelty Advertising department, which will have for its Manager, Mr. B. W. Perkins, Superintendent South Bend Fuel and Gas Company, South Bend, Ind.

These departments should prove very attractive for the meeting. Their success, however, depends largely upon the active co-operation of the members. It is, therefore, earnestly hoped that the fraternity will not be backward in sending Wrinkles to Mr. Doherty and "Advertising Schemes" to Mr. Perkins.

T. C. JONES, Secretary.

BRIEFLY TOLD.

MR. GEORGE G. RAMSDELL NAMED FOR HONORARY MEMBERSHIP IN THE FRENCH ASSOCIATION OF GAS MANAGERS.—Amongst those who ably represented the gas industry of America, on the occasion of the International Gas Congress, held in Paris, France, last September, was Mr. George G. Ramsdell, at that time President of the American Gas Light Association. During the subsequent proceedings of the 28th annual meeting of the American Association, held in Denver last October, M. Theodore Vautier, whose able direction of the doings of the International Congress earned for him the esteem and applause of the world's gas representatives, was elected to honorary membership. And it was an honor well deserved. As a sequel to all this we now have the pleasure of announcing that the Membership Committee and Council of the Societe Technique de l'Industrie du Gaz en France have nominated Mr. Ramsdell to Honorary Membership in their body, and that the formal ratification of the nomination will be completed at the next meeting of the French Society of Gas Managers the coming spring. As said above, respecting M. Vautier's naming and election to Honorary Membership in the American Gas Light Association, so we may say here that Mr. Ramsdell's preferment in the French Association is an honor well deserved.

THE THIRD ANNUAL MEETING OF THE KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION.—"The Third Annual Meeting of the Kansas Gas, Water and Electric Light Association was successfully brought off at Lawrence, Kansas, December 12th and 13th. The sessions were held in the comfortable parlors of the Eldridge House, and the headquarters were also established in that satisfactory living place. The President, Mr. Northrop Moore, Superintendent of the Wyandotte Gas Company, of Kansas City, Kas., had the satisfaction of directing an excellent meeting, whether viewed from the stand-

points of technical work, a representative attendance numerically large, or of downright fraternity. Two score and ten of the gas, water and electric light men of the State reported for duty, and the Secretary, Mr. Samuel W. Sterrett, of Kansas City, Kas., had the pleasant labor attendant upon the enrolling of quite a number of new names on the Association's membership lists. His report as Treasurer, too, showed that the Association had quite a snug balance on hand after its obligations had been discharged. President Moore's address was a very happy one, and in it he referred at length to the questions of franchise and taxation as affecting corporations, which matters are of much moment now in Kansas as well as here. In fact, the lawmakers of Kansas seem particularly hostile to incorporated companies, and in view of such hostility, Mr. Moore considered that the gas, water and electric lighting interests of Kansas would benefit the public and themselves did they favor the placing of their trading under the control of a State Commission, based closely on the structure of the Massachusetts Board of Gas and Electric Light Commissioners. From a technical point of view he strongly recommended close attention to the putting on of incandescent gas lamps, and the careful and sensible overlooking of the lamps after such had been put in use. Five papers were listed. Of these, the two which appealed more particularly to the gas interest were, respectively: "On the Use of Iron Oxide for Purifying Gas Made from Southern Kansas Coal," by Mr. L. T. Palmer, of the Leavenworth (Kas.) Light and Heating Company; and on "A Method of Protecting Underground Metal Structures from Electrolysis," by Prof. Lucien I. Blake, of the Kansas State University. Both the named papers attracted much attention and aroused good debates. The Palmer topic appealed to many of the Kansas gas men, and appealed to them strongly, for Southern Kansas coal is not noted for its freedom from sulphur. Prof. Blake's presentation of a method for protection from electrolytic effect was put forth in lucid style, and his work was warmly appreciated by the convention. We hope to reprint the Palmer and Blake papers; for they should be given publicity for the general gas good. The paper "On Needed Legislation," by Mr. John C. Nicholson, of Newton, Kas., was also well received and thoroughly discussed. The officers elected were:

President.—Mr. A. T. Rodgers, Beloit, Kas.
First Vice-President.—Mr. F. D. Aley, Wichita, Kas.
Second Vice-President.—Mr. W. G. Seabury, Pittsburg, Kas.
Third Vice-President.—Mr. W. H. Frost, Fort Scott, Kas.
Secretary and Treasurer.—Mr. S. W. Sterrett, Kansas City, Kas.
Executive Committee.—Messrs. Jesse Shaw, Northrop Moore and C. R. Maunsell.

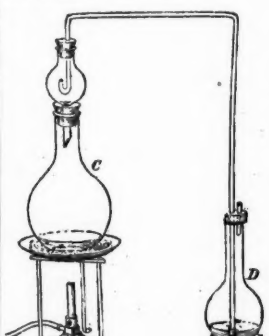
It was decided to hold the next annual meeting in Leavenworth, Kas., November 13th and 14th, 1901. Of course, the main features of the outing time were the visits to the University of Kansas, which noble pile and its good work were cleverly shown and outlined by Prof. E. H. S. Bailey and Prof. Lucien I. Blake, both beloved by every right thinking man in Kansas, and to the Haskell Institute, which is a credit to the hustling Kansas center known as Lawrence. Other pleasing events in the Association's entertainment were linked in the clever courtesies of the Merchants' Athletic Association and the Commercial Club, whose officers and members were indefatigable and successful in the ways of making everyone feel at home. This mention would be incomplete without some noting of the fraternal and hard work done by Mr. R. C. Johnston, Secretary and Treasurer of the Lawrence Gas, Fuel and Electric Light Company, who, as Chairman of the Entertainment Committee, seemed to know how to do the right thing at the right time all the time.—C."

Mr. C. H. Nettleton Assumes Executive Control of the New Haven Gas Light Company.—Much speculation has been indulged in as to the probable successor of the late Mr. Andrew W. De Forest in the Presidency of the New Haven (Conn.) Gas Light Company. The Company is a noted one in Eastern gas circles, in that it has been and is a prosperous one, although it was never presided over by a practical gas man. However, much of this success can be traced to the cool, calm common sense of its Chief Engineer, Mr. F. C. Sherman, who, while some of the executives differed as to what should be done in the matter of increasing gas sales, just kept on making gas cheaply for the executives to sell. Aside from all this, though, the surviving members of the old regimé have at last accomplished something of worth. In casting about for a successor to Mr. De Forest they have elected to their Presidency Mr. C. H. Nettleton, of the Derby (Conn.) Gas Company, whose reputation as a gas man is international. He neither asks nor requires commendation from us. Suffice it to say, then, that the Company has chosen wisely and well. Mr. Nettleton will retain his active connection with the Derby Company.

The Valuation of Gas Liquor.

At a meeting of the Nottingham (England) Section of the Society of Chemical Industry, Mr. F. J. R. Carulla, F.S.C., read a paper on the topic named in the heading, in the course of which he noted that, although containing other components sometimes of use, the ammonia is the only one generally valued in gas liquor, the large bulk of which is still produced by coal gas works. Chemical manufacturers at one time almost exclusively worked up this liquor; but gradually the business was becoming more and more one for the gas manager. Some reasons for this change were clear enough. Liquor with an average of 2 per cent. of ammonia would not stand heavy carriage charges; and large gas works away from chemical works must, therefore, deal with it themselves. Other reasons did not lie so much on the surface. Those depending on the fluctuations of the sulphate of ammonia market, the author made an attempt to remove. Gas liquor was, he pointed out, often sold for long periods at a fixed price; and as the chemical manufacturer could not insure himself by selling sulphate for a sufficiently long time ahead, he was frequently compelled to offer what might not be thought a fair price for the liquor. Hence a sliding scale of prices suggested itself as a solution of the difficulty. Naturally the methods for taking the strength of the liquor were matters of importance. The author said he found that, up to 4° Twaddel, it was quite safe to use the hydrometer. Above 4°, the true strength was generally a little higher than the Twaddel strength. But a fair allowance could always be made in the price paid for the liquor, so as not to lose the convenience of so simple a method of testing. Where the hydrometer was inapplicable—as in ammoniacal liquor from tar stills, etc.—the distillation test must be resorted to; and Mr. Carulla said he was glad to be able, by the kindness of Mr. John Phillips, the Secretary of the Bristol Gas Company, to give particulars of the modification they adopt. It was an instructive description, and was besides of special interest—being issued to would-be contractors for the purchase of their gas liquor with the forms of tender to be filled in with prices on a sliding scale based on the market value of sulphate of ammonia. The description was as follows:

Method of Testing Ammoniacal Liquor.—The facts upon which this method is based are as follows: When a mixture composed of solutions of ammoniacal salts and a sufficient quantity of some caustic alkali for which the acids of the salts have a stronger affinity than for ammonia is boiled for some time, the whole of the ammonia is driven off in a nascent state, and may be secured as sulphate by bubbling into a solution of sulphuric acid.



The apparatus employed consists of a sand bath, heated by means of a Bunsen burner; a flask *C* furnished with an india-rubber stopper, fitted with funnel having a glass stopcock, and also an eduction tube, having the end which fits into the flask *C* ground off to an angle of about 60°; a second flask *D*, two properly graduated burettes of such capacity as to contain 60 c.c. of liquid each, and divided into 0.1 cc.

The solutions employed are: (1) A strong solution of caustic soda, made by dissolving 10 grammes of pure caustic soda in 100 c.c of distilled water; (2) a normal solution of sulphuric acid, in which 1,000 c.c. contain 49 grammes of sulphuric acid (H_2SO_4); (3) a normal solution of caustic soda, in which 1,000 c.c. contain 40 grammes of caustic soda (NaHO).

These normal solutions are prepared as described hereafter, and equal measures taken of each shall, when mixed together, exactly neutralize each other, and shall neither show acid nor alkaline reaction to a coloring imparted to the solution by the addition of a drop or two of methyl orange solution, which is the indicator of acidity, alkalinity, or neutrality of solution, and is made by dissolving 1 gramme of methyl orange in 1,000 c.c. of water.

Normal Test Acid Solution.—To prepare: Place 30 c.c. of pure concentrated sulphuric acid (sp. gr. 1.842) into 1 liter of pure distilled water, mix carefully, and allow it to cool. The solution will contain rather more than 49 grammes of H_2SO_4 per liter. To determine its exact

strength, weigh out about 2 grammes of recently heated pure carbonate of soda made by heating pure bicarbonate of soda for 10 minutes at a dull red heat in a platinum dish. Add distilled water, boil, allow to cool, and add a drop or two of methyl orange solution. Then titrate with the acid solution, until the color imparted by the methyl orange changes to a pale straw color; 100 c.c. of standard sulphuric acid solution should exactly neutralize 5.3 grammes of pure carbonate of soda.

Calculation.—As 5.3 grammes of carbonate of soda exactly neutralize 100 c.c. of standard sulphuric acid solution, then as $5.3 : 100 :: 2 : x$; $x = 37.74$—*i. e.*, the number of "c.c." of standard sulphuric acid solution required to exactly neutralize 2 grammes of carbonate of soda. Say, for example, that 36 c.c. of the standard acid solution was found necessary to be used, instead of 37.74, then it is too strong, and by deducting 36 c.c. from 37.74 c.c., 1.74 c.c. remain. Therefore, it is apparent that 1.74 c.c. of distilled water must be added to each 36 c.c. of the acid solution in order to make it a standard normal acid. Consequently, the number of "c. c." of distilled water required to be added to each liter will be as 36 c.c. : 1.74 c.c. : : 1,000 c.c. : y; $y = 48.3$ c.c.

Normal Test Caustic Soda Solution.—To prepare: Put 44 grammes of pure caustic soda into 1 liter of distilled water, and when dissolved allow it to cool. This solution will be a little too strong. To standardize it, use the normal solution of sulphuric acid, 1 c.c. of which must exactly neutralize 1 c.c. of the caustic soda solution.

Calculation.—Say that 19 c.c. of the above mixed caustic soda solution neutralizes 20 c.c. of normal sulphuric acid solution. Then the caustic soda solution is too strong. To each 19 c.c. of it must be added 20 c.c. — 19 c.c. = 1 c.c. of distilled water, or to each liter 52.6 c.c. of distilled water. Then equal measures of this and the normal acid mixed together will exactly neutralize each other.

Assuming that all the vessels are perfectly clean, that the flask *C* has been placed in the sand bath, and that the junctions are all perfectly tight, the operations are commenced by charging the flask *D* with 50 c.c. of the normal test acid. The flask is then placed in position so that the end of the eduction tube is within ¼ inch from the bottom of the flask. 200 c.c. of water is next poured into the flask *C*, and 20 c.c. of gas liquor added, and the india rubber stopper placed in the flask *C*. 20 c.c. of the *strong soda solution* must now be poured into the funnel, the cock opened, and closed immediately after the fluid has run down into the flask. The Bunsen burner, on being lighted below the sand bath on which the flask *C* rests, raises the contents to boiling point, at which temperature it must be kept until two thirds of the contained liquor is evaporated, by which time the whole of the ammonia will have passed over into, and will have been absorbed by, the normal test acid contained in the flask *D*.

The crackling noise which sometimes occurs at the commencement of boiling—caused by the rapid absorption of the ammonia by the acid in the small flask—need cause no alarm.

When the ammonia has ceased to come over, the flask *D* is removed and allowed to cool, and its contents then colored by the addition of a few drops of the methyl orange solution.

The burette having been charged with 60 c.c. of normal test solution of soda, and the flask *D* placed upon a white paper or glazed white tile in a good light, the solution in the burette is dropped into the flask until the red liquid therein changes to a pale straw color.

The strength of the gas liquor subjected to test is indicated by the number of "c. c." of normal soda solution used in titration, subtracted from the number of "c.c." of normal acid used to absorb the distilled ammonia. Thus, if 30 c.c. of soda solution be drawn from the burette, then, as 50 c.c. of test acid were taken, 50 c.c. — 30 c.c. = 20 c.c., being the number of "c.c." of the test acid neutralized by the ammonia in the gas liquor.

Each "c.c." of these two normal solutions corresponds and is equal to 0.017 gramme of ammonia (NH_3); 20 c.c. are therefore equal to 0.34 gramme of ammonia. But as 20 c.c. of gas liquor were taken, 20 c.c. : 0.34 gramme : : 100 c.c. : z $z = 1.7$ per cent. of ammonia.

The "Ounce" or "Acid" Strength of the Liquor.—To change the percentage into "ounce" or "acid" strength, multiply by 4.61; $1.7 \times 4.61 = 7.83$, which represents the number of ounces of sulphuric acid (H_2SO_4) it would take to neutralize the whole of the ammonia contained in a gallon of the liquor subjected to test.

All the operations are of the simplest character, except the preparation of the test solutions. These, however, can be purchased; but they should always be checked.

One important matter remains to be mentioned—viz., the correctness of the measures and burettes employed. These must be in absolute agreement one with the other in measurement, otherwise grave errors will arise. Unfortunately, many of the glass measures and burettes sold are very inaccurate, and differ greatly in capacity among themselves, to the extent of 5 or 6 per cent. But they can be easily tested by filling them with distilled water, and weighing it.

The author went minutely into some other considerations that should govern the preparation of a sliding scale—including the fixed and varying manufacturing charges—evolving a formula of easy application, by which an illustrative table was constructed. Mr. Carulla concluded by saying that, although figures had been used for the sake of clearness, he only wished to draw attention to a principle—viz., that of differentiating between the fixed and the varying manufacturing charges, which could be modified according to circumstances, but which he believed, if properly applied, would be capable of introducing harmony among the contending interests of the gas and the chemical industries.

The Chairman said he was surprised to hear that anyone used the hydrometer as a test for gas liquor. He understood that the liquor was bought and sold by the "ounce strength."

Mr. Carulla remarked that the ounce strength obtained by saturation of the liquor with sulphuric acid also failed to give a true indication in many instances.

The Chairman said—Precisely; the ascertainment of the ounce strength by the distillation test is what I refer to.

Mr. Carulla—I have experience of more than a dozen gas companies by whom the hydrometer is found a convenient and reliable instrument. Of course, when buying liquor from tar distillers a distillation test is indispensable, as in that case the hydrometer gives no indication of the strength.

The Coal Fields of Natal.

By Mr. Wm. Taylor Heslop.

The coal measures of South Africa are usually considered to belong to the Triassic formation, but their precise geological horizon can by no means be regarded as definitely determined. South African coals may be divided into three classes, as distinguished by the appearance of the coal alone: (1) Bright coal, similar in appearance to British bituminous coal, showing a cubic cleavage, but with more distinct horizontal lamination than British coal. (2) Dull coal, similar to splint coal, with cubic or irregular cleavages, but often with a coarse grain, and always wtth a much higher proportion of ash than the bright coal with which it is immediately associated. (3) Semi bright coal, a fine grained coal with a conchoidal fracture and no lamination. In appearance it resembles some of the Welsh or Irish anthracites, but it has a graphitic luster. It contains from 25 to 35 per cent. of ash. The upper unworked portion of the Clydesdale (Transvaal) coal seams forms a good example of this variety. The dull coal and bright coal are often found inter laminated, the one gradually merging into the other. It is a noteworthy feature of the South African coal fields that where the seams are abnormally thick there is a greater proportion of dull and impure coal, and such seams are less constant in character and continuity than the seams of medium thickness. Thus the seams of Natal, which are comparatively thin, contain much less dull or impure coal, and are more uniform in character than those of the Transvaal.

The Natal coal field occupies the northern portion of the colony, forming a triangle of which the base is a line drawn east and west, about 12 miles north of Ladysmith, and the two sides are, approximately, the boundaries of the colony to the north of that line. The average elevation above the sea is about 4,000 feet, although near Laing's Nek coal is found almost 5,000 feet above sea level. During September, 1899, the last full month's working before the commencement of the war, the total output was 40,351 tons. Of this quantity 19,407 tons were sold for bunker trade at Durban, and 508 tons were exported. In its production 128 Europeans, 1,678 natives, and 878 Indian coolies were employed.

The Dundee Colleries occupy the leading position among the producing mines. Coal has been worked there during the last 30 years, although not to any great extent until some 10 years ago, when the output reached 4,000 tons per month. The coal has the following average analysis: Volatile matter, 16.63; fixed carbon, 70.53; sulphur, 4.18; ash, 8.66. Although higher in sulphur and ash than some of the competing coals, the larger proportion of fixed carbon enables it to hold its own.

The Natal Navigation Collieries are situated about 4 miles from the Natal Government Railway, with which they are connected by means of a branch line. The analyses of the coal which have so far been made are unreliable, but the coal undoubtedly contains at least 25 per

cent. of volatile matter, and less sulphur than the Dundee coal; unfortunately, it is very friable and will not stand handling without breakage.

The St. George's Colliery Company holds ground both east and west of the Natal Navigation Colliery, but the working of the eastern part was abandoned and operations are now conducted on the western side. The occurrence of an explosion last year hampered the development of the mine, and the profit earning stage was reached only a month or two before the commencement of the war. In quality, the coal is almost the same as the Natal Navigation coal, but it is not so friable.

The Elandslaagte Collieries, the only productive coal mines situated south of the Biggarsberg, possess the advantage of being nearest to the market, which compensates for the thinness of their seams and the slightly inferior nature of their coal.

The Natal Marine Collieries are situated about 2 miles east of Dundee, and are the most recent producers in the colony. By extensive boring, an area of about 1,000 acres of coal, similar in section and quality to that of the Dundee collieries, and lying for the most part very near to the surface, has been proved. Although the coal had only been in the market a few months when the war broke out, it had already acquired a very good name and ready sale.

The New Campbell Collieries.—Unfortunately, the main shaft of these mines was located within 100 feet of an enormous dolerite dike, and where the coal was struck it only contained 4 per cent. of volatile matter. After 1,400 feet of driving, at right angles to the dike, bituminous coal of very good quality had just been proved when work was suspended.

The South African Collieries were promoted by the De Beers Mines, with the idea of ultimately supplying coal to the Kimberly market. In sinking the shafts, a horizontal sheet of dolerite, or whinstone, 153 feet in thickness was penetrated. The rock was so hard that progress was slow. Coal was struck at a depth of 360 feet, or 86 feet below the bed of dolerite, and gave the following analysis: Volatile matter, 8 6; fixed carbon, 79.7; ash, 9.7; water, 2.0. The percentage of sulphur in the ash was 3.35. Boiler tests, though variable in results, were not sufficiently satisfactory to justify further work at that point, and it will probably be found necessary to sink fresh shafts on one of the bituminous areas within the property, which covers about 16,000 acres.

In the Newcastle District, the Newcastle and East and West Lennoxtown collieries are furnishing small supplies. The coal in this district contains about 30 per cent. of volatile matter. Some of it is very good indeed, but the seams are more variable in quality and thickness than those of the Dundee district. Between the Natal Navigation Colliery and the town of Newcastle, coal of very good quality and thickness has been proved at a depth of 500 feet at Dannhauser, in a shaft sunk by the Durban Collieries Syndicate. The top seam shows 3 feet 10 inches of coal. The bottom seam shows 4 feet 2 inches of coal, a parting of 2 inches of shale and below that 1 foot 3 inches more of coal. The top seam shows 40 per cent. volatile matter; 49.78 fixed carbon; 9.42 ash; 0.80 moisture. The amount of sulphur is not stated. The bottom seam is richer in fixed carbon, analysis showing 31.20 per cent. volatile matter; 57.56 fixed carbon; 10.44 ash; 0.80 moisture.

Up to the present, the bunker trade of Durban furnishes the largest market for the coal output, the next largest consumers being the Natal Government railways. The railway rate for the transport of coal is 9 cents per ton per mile, or $2.16 per ton for the distance of 240 miles from Dundee to Durban. Since February, 1899, to encourage the export trade, a rebate of 33 per cent. on the ordinary rate for all coal exported from the colony has been made. The loading facilities at Durban harbor are meager, all coal being loaded into ships in baskets or bags on the backs of Kaffirs, and at a cost of 36 cents per ton. Improved arrangements for loading will be necessary before any great expansion of the export trade can take place. It is to Cape Colony that Natal coal owners are now turning their attention, in the hope of capturing the market at present supplied by Welsh coal. It is estimated that the requirements of the Cape Colony amount to 500,000 tons per annum, which have hitherto been supplied by Welsh coal, by collieries in the Stormberg and Indwe districts of Cape Colony, and from Vereeniging on the Vaal river.

The largest market for coal in South Africa is that of the Witwatersrand gold fields. Hitherto Natal coal has been shut out from the Transvaal by a prohibitive duty of $1.20 per 100 pounds. When the duty is removed Natal coal must be prepared to pay a railway freightage of from 96 cents to $1.20 per ton over and above that paid by the Middelburg coal. This difference would be largely caused by the freight from the Dundee district to the Transvaal border, and it would not be materially affected by any future readjustment of railway rates in the Transvaal. Whether Natal coal is able, on account of its better quality, to carry this rate and compete in the Witwatersrand market with the Middelburg coal must be left for future trials to decide.

Effect of Quality on the Consumption of Cas.[1]

At the December meeting of the London (England) Section of the Society of Chemical Industry Mr. W. J. Dibdin read a paper on the named subject. Before reading his paper Mr. Dibdin said he had no object in bringing the matter before the Society except to have the scientific facts of the question elucidated. He did not wish to prejudice their minds in any way by trying to emphasize any point unduly, and if it might appear that any particular point was emphasized somewhat strongly he asked them to take that as being merely the outcome of the facts as they appeared to him. It was for his audience to form their own conclusions and to criticize as severely as they would, in order that the truth, and nothing but the truth, might result from their deliberations. A scientific society like theirs had but one desire—to arrive at the truth, however the result might affect their individual prejudices.

Proceeding with his paper Mr. Dibdin said it was a curious fact that in the minds of many who discussed the subject there appeared to be a vague notion that all coal gas was more or less of the same lighting value and that the only point for discussion was the price to be paid for a given quantity. The use of gas for heating and for lighting by means of incandescent mantles also complicated the question. If none but incandescence burners were employed, then it might be granted at once that the old idea of "illuminating power" of coal gas must be very largely and seriously modified—so much so that the expression "heating power" might safely be used in its place. As long, however, as the great proportion of the gas was consumed in ordinary luminous flame burners there was no excuse for neglecting the effect of variations in quality upon the quantity of gas required to give normal or "unit" illumination. Taking the extremes, the value might depend upon quantity only if the basis were that of the incandescent burner; but even then the heating value of the gas should be taken into account. On the other hand, if the basis were that of a flat flame burner, then the value must depend upon illuminative effect as well as on the quantity required to be consumed.

To ascertain the value of these considerations the author made a series of tests with different burners and different qualities of gas to ascertain the quantity of gas required to give the maximum quantity or "normal" light from any given burner when burning 16-candle gas under the most suitable conditions. The first series was made with coal gas at Widnes; the second with gas supplied by the Gas Light and Coke Company; the third with gas supplied by the South Metropolitan Gas Company; and the fourth, fifth and sixth with coal and water gas in various proportions. For the purpose of the first series of experiments, Mr. Carr, the Gas Manager, prepared different qualities of gas from time to time and stored them in an experimental 100-feet holder, which was connected to the author's photometer. The procedure was to first carefully test the quality of the gas when burned at the rate of 5 cubic feet per hour in a No. 1 London Argand, and then to burn it in various gas burners in succession, making photometrical determinations of the light and estimations of the quantity of gas consumed. The value obtained with the London Argand was 16.2 candles; the result of independent tests by different observers, using two photometers, viz, the closed Evans photometer on the works, using candles as a standard, and the author's portable bar photometer, using the Dibdin 10 candle pentane Argand standard as recommended by the Board of Trade Committee. The value of the gas being thus ascertained, the standard London Argand burner on the portable photometer was removed and a Sugg's "table-top" burner No. 4 placed in position, and the gas adjusted until a fair and even burning flame was obtained, which was found to be equal to 14.4 candles. The quantity of gas consumed was then ascertained by means of the experimental meter, which was found to indicate a rate of 5.3 cubic feet per hour. In like manner 28 burners were tested in succession with the same gas, and the results recorded.

On the completion of the tests of all the burners with 16.2 candle gas, the gas unused in the experimental 100 feet holder was again examined to make certain that no change in the illuminating power of the gas had taken place, and the remainder displaced and the holder filled up with gas of another quality, when the tests were repeated in a precisely similar manner, the greatest care being taken to insure that, as far as possible, the experiments were strictly comparable.

1. *Gas World.*

In certain instances with low grade gas the burners could not properly consume sufficient gas to give the amount of light afforded when the 16-candle gas was employed, and corrections had therefore to be applied. Thus, in the case of Sugg's table top burner No. 7, 24.6 candles of light were obtained with gases down to 12.2 candles, but when 11.2 candle gas was used, only 20.2 candles could be obtained instead of 24.6. As the consumption of gas was 10.8 cubic feet per hour, 13.1 cubic feet would have been necessary to yield the 24.6 candles of light. These corrections more particularly applied to burners adapted for very rich gases when employed with low grade gases. On the basis of a sufficient number of burners being employed to burn the total quantity of gas of a given quality to yield the volume of light required, this method of approximation would probably give slightly too low a result.

The author exhibited a wall diagram showing the cost of the unit of light obtained by burning different qualities of gas in certain representative burners, and assuming the price of 16-candle gas to be 2s. 6d. per 1,000 cubic feet. Commenting upon this diagram he remarked that by interpreting the variations in consumption of gas into relative cost it wou d be seen that, in order to obtain equal degrees of illumination with varying qualities of gas, in the case of a No. 4 Bray's burner, the actual cost of the gas to the consumer, on the basis of light for money, would be as follows:

Illuminating Power of Gas.	Quantity Required to Give Light Equal to 1,000 Cubic Feet o f16-candle Gas. Cubic Feet.	Actual Cost of Gas at 2s. 6d. per 1,000 Cubic Feet. S. D.
19.0	600	1 6
18.0	700	1 9
17·0	820	2 1
16.0	1,000	2 6
15.0	1,340	3 4
14.0	1,800	4 6
13.0	2,400	6 1
12.0	3,040	7 9
11.0	3,750	9 6

As it might, he continued, be thought that No. 4 Bray was an exceptional burner, he would take No. 5 Bray, which might reasonably be looked upon as an average burner generally employed, and ascertain in the above manner the cost of equal light intensity for different qualities of gas, viz.:

Illuminating Power of Gas.	Cost of Gas per 4,000 Cubic Feet. S. D.
19.0	1 7
18.0	1 10
17.0	2 1
16.0	2 6
15.0	3 0
14.0	3 7
13.0	4 3
12.0	5 4
11.0	7 1

On this basis it was seen that any variation in price per thousand cubic feet for each alteration in the illuminating power of the gas should be greater than had hitherto been supposed. On the other hand, these facts explained the common complaint as to the otherwise apparently inexplicable rise in the amount of the gas bills—a fall of 2 candles in quality causing a rise, in the case of Bray No. 5 burners, of 44 per cent. on the gas bill; whilst, when the gas was down to 12.6 candles, the amount of the gas bill was doubled.

In the case of the Welsbach and the best Argand burners, which, however, were used by the public to only a very limited extent as compared with the flat flame burners, the results were less disproportionate, and a moderate reduction in price for each candle power would not be unreasonable; but, unfortunately, in order to obtain a problematical advantage to the users of gas for heating purposes, the vast majority of those who employed the gas for illuminating purposes in the burners commonly used would be mulcted to a most unjust and injurious extent.

Similar tests were made at the author's laboratory at Westminster and at the Southwark gas meter testing station of the London County Council, the one with gas supplied by the Gas Light and Coke Company, and the other with gas supplied by the South Metropolitan Gas Company. In both cases the low qualties of gas were obtained by passing the ordinary supply through linseed oil, and the high qualities by adding petroleum, and allowing the gas to stand in the holder for some hours. The results obtained confirmed those arrived at at Widnes.

For the purpose of ascertaining the effect of the use of water gas, the author conducted similar series of tests, the first with a mixture of lower power coal gas and water gas in varying ratios, and the second with mixtures of high power coal gas and water gas. The first series showed that with increased percentages of water gas the quantity of gas required to give unit light with a Bray's No. 4 burner rose to as much as 160 per cent., whilst with the standard Argand burner the increase was only 6 per cent., and with the Welsbach mantle it was nil. In the tests with high power coal and water gas with Bray's No. 4 fishtail burner, the increase in consumption was 250 per cent., with 75 per cent. water gas, but with the standard Argand there was no increase, whilst with the Welsbach mantle there was an actual decrease in the consumption of 7 per cent.

[In the following tables some of Mr. Dibdin's results are given. The figures show the number of cubic feet of the various gases required to produce unit illumination by the several burners.]

TABLE VII.

	Pure Coal Gas.	Water Gas. 20 p. c.	48 p. c.	73 p. c.	100 p. c.
Standard Argand.....	5.2	5.3	5.6	5.4	5.4
Sugg's table top No. 5.....	4.9	5.4	6.0	7.6	9 3
" " " " 3.....	5.8	6 9	7.6	8.8	9.0
Bray's fishtail No. 4.....	5 6	8 0	8.7	9 6	14.5
" " " 5.....	0.9	8.0	8.7	9 4	16 3
Sugg's F Argand...	6.5	6.7	6.8	6.8	6 8
Welsbach "C" burner....	3.9	3.6	3.9	4.0	3 9

TABLE IX.

	Pure Coal Gas	Water Gas. 27 p. c.	75 p. c.
Standard Argand.....	4.7	4.7	4.7
Sugg's table top No. 4...	4.5	5.7	7.3
" " " No. 5...	4.6	4 9	5.9
Bray's fishtail No. 4.....	3.1	6.4	10.0
" " No. 5.....	4 0	5.0	11.1
Sugg's F Argand.....	6.1	6 2	6.6
Welsbach "C" burner..	4.2	3.3	3,9

TABLE XI.

	Pure Coal Gas.	Water Gas. 10 c. p.	27 p. c.	50 p. c.
		12.2 p. c.	18 c p.	
Standard Argand.....	5.0	4.7	4.6	
Sugg's table top No. 4...	5.4	5.7	5.0	
" " " No. 5...	5.4	4 9	4 9	
Bray's fishtail No. 4.....	4.4	6.4	5.4	
" " No. 5.....	5.1	5.0	4.8	
Sugg's F Argand.....	6.4	6.2	6.2	
Welsbach "C" burner..	3 5	5.7	4.0	

TABLE I. *Widnes Tests.*

Illuminating power of gas.	11.2	12.2	13.5	14.2	15.2	16.2	17.2	19 2
Standard Argand.....	6 2	6 0	5.7	5 4	5.1	4 9	5.0	4.7
Sugg's table top No. 4.....	11.2	9 7	7 7	6.4	6.1	5.3	4 5	3 9
" " " No. 5.....	9 5	7.8	6 2	5.7	5.5	5 3	4.6	4.1
Bray's fi-htail No. 4.....	15.5	13 4	10.5	9.0	5.6	4.3	3.1	2 6
" " No. 5.....	14 0	10.6	9.8	6 8	5 9	5.0	4.0	3.2
Sugg's F. Argand.....	7.7	7.4	7.2	6.6	6.4	6.3	6 2	6 1
Welsbach "C" burner....	4 9	5.0	4.0	3.7	3.5	3.5	4 2	3.4

TABLE II. *Gas Light and Coke Co.*

	12.0	13 5	14.5	16.0	16.5	19.0
Standard Argand.....	5.8	5 4	5 3	5.0	4.8	3.9
Sugg's table top No. 4.....	12 9	9 4	9 0	5.2	5 0	3 8
" " " No. 5.....	10 4	8 0	7.4	4 8	4 7	3.7
Bray's fishtail No. 4.....	15 1	10 7	10.1	4 7	4.6	3.2
" " No. 5.....	14 8	8 8	10 3	5.4	5.2	3.9
Sugg's F. Argand.....	7 3	7.0	6 8	6.2	6 0	5.4
Welsbach "C" burner....	3 3	2.9	3.2	3.4	3.3	2.5

TABLE III. *South Metropolitan Gas. Co.*

	12.5	14.5	16.0	16.5	17.2	18.0
Standard Argand.....	5.5	5.3	5.0	4.8	4.4	4.3
Sugg's table top No. 4.....	6.6	5.9	4.5	4.4	4.3	3.5
" " " No. 5.....	6.3	5.3	4 7	4.6	4.4	4.0
Bray's fishtail No. 4.....	6.9	5.3	5 0	3 4	..	2.8
" " No. 5.....	6.7	5.9	4.3	4.2	3 8	3.4
Sugg's F. Argand.....	7.1	6 4	6.0	5.8	5.6	5.3
Welsbach "C" burner....	4.0	4.0	3.4	3.3	3.5	2.9

Power and Light for the Machine Shop and Foundry.

[Abstracted from a paper read by MR. F. R. JONES at the December Meeting of the American Society of Mechanical Engineers.]

The writer has recently had occasion to investigate the plants of two concerns with regard to electric power transmission and light. In one of these the floor space over which light and power are required is about 7 acres; in the other, about 4 acres. The arrangement of the floor space is radically different in the two cases. In the first there are several buildings entirely separate and at some distance from each other, and the floor space is nearly all upon the first floor, there being a small amount upon the second floor and next to nothing on the third floor. In the second the floor space is nearly all in an L-shaped building, partly of four stories and partly of three, and, in addition to this, a

small 2-story structure setting close to the other building within the inner angle of the L.

The output of each establishment is in a way similar, both producing iron machinery chiefly. In the smaller establishment the product is much lighter in weight than in the larger. The operating machinery in the two plants is quite similar. The lighter machinery is about the same in each, but the larger has a considerable amount of heavy machinery which has no counterpart in the smaller. Both plants were examined to see what requirements would have to be fulfilled by an electric system, or systems, for power transmission and lighting.

The selection of a single system from which all apparatus might be operated was based upon the conviction that, for machine shop and factory purposes, it is exceedingly desirable to be able to interchange similar apparatus and to place any piece of apparatus anywhere upon the system, thus obtaining the maximum flexibility and greatest facility for operating portable machine tools at any point, and also to allow for alterations and extensions of the works. The study of the requirements of every form of apparatus that might be brought into use and demand current from the system was naturally necessary in order to decide whether direct current, single phase alternating or polyphase should be used.

The oldest of machine tools, the lathe, was taken up first, and since in both establishments it was deemed advisable to have some lathes driven individually by variable speed motors, and that the variation of speed should cover, by small steps, a considerable range, the only thing that seemed satisfactory for this purpose in the present state of speed regulation for different types of electric machinery was the direct current. And, in order that the range of speed variation might be as great as possible, the multiple voltage system appeared to be advisable, even though the speed regulations were to be made, for a given supply circuit voltage, by rheostatic control of the current in the magnet coils of the motor.

Other machines of a nature in a way similar to the lathe, so far as their driving is concerned, among which may be included the boring mill, drill press, shaper, slotter, gear cutter and screw machine, can be operated satisfactorily under conditions of speed variation similar to those which answer for the lathe.

The planer, whose reciprocating motion requires the reversal of nearly every part of its machinery, presents a problem which is not yet satisfactorily solved for electric driving by a direct connected motor. The nearest solution that has been reached is to drive its counter shaft in one direction continuously, just as it might be driven from a line shaft, and effect the reversals of the machine in the ordinary method common to mechanical driving. The ability to secure different cutting with maximum return speeds for machines of this type is unquestionably desirable when working upon different kinds of materials or for taking heavy and light cuts. Different speeds can be obtained readily with many types of direct current motors by rheostatic control of the field magnet current and, therefore, this feature needs no further attention than already given the lathe.

Nearly all electric hoists and cranes are now operated by constant pressure direct current motors. They seem to be at least as satisfactory as those driven by any other type of current.

Constant potential direct current arc lamps have long shown themselves efficient, durable and otherwise satisfactory. They can be operated individually and economically at any pressure between 100 and 125 volts, even though the pressure fluctuates considerably. (It is not intended that these are the limiting pressures of satisfactory service.) The lamp is, of course, more economical at its rated pressure without any of its rheostatic resistance in circuit. Incandescent lamps have long been operated at from 100 to 110 volts with perfect satisfaction.

Motors for electric cranes and for general power purposes about the machine shop can be operated satisfactorily at any of the ordinary pressures for running motors, but it was not thought advisable, especially in connection with the conditions to be met in operating other apparatus, to give them a pressure greater than from 220 to 250 volts. The higher the voltage, within practical limits, the greater the economy of wire in the electrical circuit, of course. But, even leaving the requirements for other apparatus out of consideration, voltage as high as 500 is not desirable for the machine shop and foundry, for there is always a considerable degree of probability that employees will receive shocks by coming in contact with the wires or machinery. The writer's experience has given him sufficient respect for a 500-volt circuit to make him wish to keep others away from it.

On the whole, it was, therefore, concluded that 220 volts for the majority of motors and 110 volts for arc and incandescent lamps would be the most suitable. These voltages can be obtained, as is well known, by the 3-wire system which has been so long in use.

In order to obtain information as to the amount of power required for driving different parts of the plant numerous tests were made upon individual machines, groups of machines, sections of line shafting, cranes and elevators. Although so much data have already been published showing the power required to drive machine tools for iron working and wood working, it is believed that there are some points of sufficient value among those obtained in these tests to entitle them to attention. The data given below are of a nature not generally found in the reports that have been made upon electric driving, but present some rather unusual cases.

Power Required by Lathes.—The power required to drive a couple of lathes, one of 48 inch and the other 36-inch swing, was taken when both were polishing hollow cylindrical columns, one 10 inches in diameter and the other 12 inches. In both cases the polishing laps gripped the work so tightly as to keep the driving belt of each lathe on the point of slipping. The speed was as high as could be safely used for machines of this size. To drive the 2 lathes together under these conditions something over 7 mechanical horse power delivered by the motor to the belt running from its pulley was required. It can be seen that this is considerably more than is required for a lathe performing any of the operations common to machine construction in the ordinary shop. It may not equal the amount of power necessary for taking heavy cuts upon large steel shafts, heavy gun tubes and jackets, etc. It does represent the power, however, which must be used as a basis to determine the size of a motor to drive a lathe which must do such work as demanded for these two. If a number of lathes for this class of work are to be grouped together, and there is a possibility, which is very probable, that several of them may have polishing under way at the same time, and therefore demand a maximum amount of power, the motor for driving them as a group must naturally have a capacity equal to the combined maximum demands of all of them, due allowance being made for its ability to stand overloading for a short period of time.

Power Required by Planer.—Although it is well known that the power required to drive a metal working planer is generally greater on the return stroke than for the forward, or cutting, stroke, and that, at the time of reversal, the power demanded is exceedingly greater than at any other time, the following data may not be out of place.

Two planers, one with 22 foot table and 120 inches between housings and the other with 25 foot table and 72 inches between housings, were both driven by 1 motor belted to a jackshaft, which in turn drove the 2 countershafts of the planers. The following data were obtained:

120-inch Planer with 22 foot Table and 72-inch Planer with 25 foot Table. 230 *Volts.*

Both machines driven by 1 motor. Jackshaft running in all cases.

Amperes.	
20	One countershaft.
60	Average for 120-inch planer on cutting stroke, light cut, and 1 countershaft.
55	120-inch planer reversing from return to cutting stroke.
110	120-inch planer reversing from cutting to return stroke.
27	Both countershafts.
240 } 250 }	Both planers reversing from cutting to return stroke.

Both machines were working upon rather heavy castings and taking comparatively light cuts at short strokes over bosses and parts of the castings where other members of the machines were to be attached. The power, therefore, is approximately that which would be required to drive the machines without taking any cut, but carrying loads upon their tables. It may be noticed that the amount of power for reversing the 120-inch planer was about 1.8 times that for its average running at times when not reversing. When it happened that both machines reversed at the same time from the forward, or cutting, to the back, or return, stroke, the power required ran up to a very great amount, more than 60 mechanical horse power. This amount of power was not indicated by the instantaneous extreme throw of the ammeter needle, but was the reading at which the ammeter stood steadily for some seconds, a period long enough to make the demand distinctly felt by the engine and generator.

A planer with a 24-foot table and 60 inches between housings showed the following amount of power required:

60-inch Planer with 24 foot Table. 230 *Volts.*

Amperes.	
7	Shafting only.

Amperes.	
8 9	Forward stroke without cut.
10-15	Light portion of cut on rough casting, $\frac{1}{4}$-inch feed.
15-20	One tool cutting cast iron $\frac{6}{16}$-inch, deep × $\frac{1}{4}$-inch feed.
20-25	One tool cutting cast iron $\frac{7}{16}$ inch deep × $\frac{1}{4}$-inch feed.
20 25	Cutting $1\frac{1}{16}$-inch groove in cast iron with square nose tool; feed between $\frac{3}{32}$-inch and $\frac{5}{32}$ inch; groove not cored.
35	Reversing from return to cutting stroke.
45	Reversing from cutting to return stroke.

It may be noticed that the power required for reversing this machine, especially from the cutting to the higher speed return stroke, is nearly double that for the forward stroke when cutting.

Power Required by Crane.—Of the 20 odd traveling cranes in one establishment, 10 were tested for the power required to drive them. Of these 10, some were driven electrically and some mechanically. The majority of the electrical cranes were of the ordinary types designed for electric driving. One was a remodeled crane which had originally been driven mechanically by a square shaft running alongside the building parallel to the track. Some of the mechanically driven cranes were furnished power by a square shaft alongside the building and parallel to the track, and others by a flying rope running alongside the track. Obviously, in providing for the power to drive a crane it is necessary to know the maximum amount of power that it may demand for a period of time great enough to make the demand appreciably felt by the generating plant. In this respect the following data, obtained from 3 electric traveling cranes of 30-tons capacity each, all traversing the same track above the foundry floor, show how great may be the demand, for an appreciable period of time, by some one of the cranes, and, with perfect possibility, by all of them at the same instant.

Each of the 30 ton cranes was equipped with 4 motors, 25-horse power for bridge travel, 8-horse power for trolley travel, 25-horse power for the main hoist and 16-horse power for the auxilliary hoist.

30-ton Electric Traveling Crane No. 1. Pressure, 240 Volts when Crane was Taking no Current.

Amperes.	
125	Bridge starting, no load.
50	Bridge traveling uniformly, 350 feet per minute, no load.
33 to 40	Lowering, no load.
105	Starting to hoist, no load.
36	Hoisting uniformly, no load.
145	Bridge starting, 20-ton load.
50	Bridge moving uniformly, 240 feet per minute, 20-ton load.
95	Hoisting 20 tons uniformly at 10 feet per minute.
310 200 150	General maneuvering, 20 ton load.

30-ton Electric Traveling Crane No. 3. 240 Volts.

Amperes.	
90	Bridge starting, no load.
50	Bridge traveling uniformly, 535 feet per minute, no load.
38	Lowering uniformly, no load.
40 to 45	Hoisting uniformly, no load.
150	Bridge and trolley starting, 20-ton load.
30	Trolley at uniform speed, 20 ton load.
34	Hoisting uniformly at 11 feet per minute, 20-ton load.
240	Bridge and trolley maneuvering, reading for 3 seconds, 20-ton load.
320 250 200 230 180	General maneuvering, 20-ton load.

It can be seen, by examining the data obtained from these 30-ton cranes, that when all the motions on one were in operation simultaneously, and when two or more of the movements were started at about the same instant, the demand made for power during this general maneuvering was very great indeed. The readings given for such general maneuvering for two of the cranes when carrying a load of 20 tons each, the reading running as high as 320 amperes in one case and 310 in the other, represent demands for current during periods of from 5 to 10 seconds duration, as shown by the steady reading of the needle of a dead beat ammeter. It not unfrequently happens that such a condition comes about in everyday practice. That two or more of these cranes did, when in regular service, make very heavy demands for current at the same instant, was clearly shown by watching the ammeter at the switchboard of the generator supplying current to the 3 cranes only. Although this generator had sufficient capacity to operate several 30-ton cranes under what might be called average load, and the magnetic circuit breaker for the generator was set considerably above the steady load capacity of the generator, it was not an unfrequent occurrence for the circuit breaker to open up the circuit on account of the great momentary demands made for power by the cranes.

Tests upon a 15 ton electric crane, two 5-ton electric cranes, a 15-ton flying rope crane, a 15-ton square shaft crane and a 15-ton square shaft crane remodeled to be driven direct by an electric motor, all showed similar heavy momentary demands for current under general maneuvering

Power Required by Elevator.—A somewhat surprising condition was found in one of the elevators, which, during the regular operation of the shop, was driven mechanically from the line shaft by means of a worm and worm wheel connected to a winding drum for the elevator cable. The elevator was of comparatively small capacity, and should not ordinarily require probably more than 5-horse power to drive it. But, apparently on account of some fault of the worm and worm wheel mechanism, the very excessive amounts of power shown in the data given for this elevator were sometimes required.

Elevator Operated by Worm and Worm Wheel.

Mechanical Horse Power.		
Going up.	Coming down.	
19.2	10.4	No load.
16.5 to 21.8	...	No load.
...	0.1	After running some time.
2.5	...	One man on.
...	0.1	Countershafting only.
7.8	...	2-ton load, estimated.
7.3	...	2-ton load, estimated.

When well oiled 15 amperes were at one time required to lower the cage without load; but on the following trip, immediately after, 60 amperes were required to lower without load. The next trip down took only 15 amperes. The same variation of power occurred throughout the test.

The worm and wheel mechanism appeared to be in proper condition, however, as far as could be seen by outside inspection. It was well lubricated by a bath of oil and flake graphite, in which the worm ran. Here seems to be a lesson in the use of the worm and worm wheel mechanism setting forth the fact that care should be taken in its adjustment, and to see that the rubbing surfaces of the worm and wheel are kept in proper condition.

Power Required by Fans.—Two fans, used in connection with steam coils and hot air pipes for heating of buildings, took the following amounts of power to drive them. They were both of the radial blade, fan wheel type (the blades arranged as on the paddles of a side wheel steamboat). The casing of the larger measured 108 inches in diameter by 60 inches wide, the latter measurement taken parallel to the main shaft. There were two tangential discharge openings in the case; one at the top, 24×60 inches, and another at the bottom, 54×28 inches; the larger dimensions in both openings were parallel to the fan shaft. The rotating part of the smaller fan measured 60 inches in diameter by 28 inches wide. It had a single outlet, 29×31 inches. Each fan had been installed by its manufacturer in connection with the other parts of the heating system. The larger one was not brought up to its rated speed because the power required to drive it was much more than anticipated when a motor of 20-horse power capacity was belted to it. The slipping of the belt was the real limiting cause for not applying more power with the 20-horse power motor. There was not time to substitute a larger motor or another belt:

108×60-inch Fan for Heating.

Mechanical Horse Power.	Revolutions per Minute.
20.6	160
23.6	180

60×28-inch Fan for Heating.

Mechanical Horse Power.	Revolutions per Minute.
0.8	120
1.2	176
4.8	275
11.4	360
12.5	370

The Current.—By examination of the data given above it may be seen that the constantly recurring and great momentary demands for power made by cranes and hoists would necessarily affect the pressure in the wires carrying current to them from the switch board in the power house. Hence the circuit feeding the crane and elevator motors

would not be suitable for also furnishing current to motors which require to be run at even a fairly constant speed, or even hardly for incandescent lights in places where a steady illumination is not essential. It would be difficult to find constant voltage arc lights that would operate with even a fair degree of satisfaction at the points of greatest variation of pressure in the circuit. It therefore becomes necessary to have what might be called a "crane circuit" for at least the majority of the larger cranes in an establishment of the proportions of those mentioned earlier in this paper.

The incandescent lights for use in offices, drafting rooms, and possibly some parts of the shop itself, as the tool room, and where the small and more accurate parts are manufactured, must have a pressure in the circuit leading to them which, at least, does not fluctuate rapidly, even though it may be allowable for it to vary slowly to a slight extent. A lighting circuit, primarily intended for incandescent lighting, therefore, also becomes a necessity.

Such machinery as lathes, drill presses, shapers, milling machines, slotters and gear cutters does not ordinarily need to be driven at a speed that is even very uniform. Variation of speed on each side of the normal is allowable to a considerable extent in many cases, provided the variation is not a jerky one, such as often comes on line shafting used to drive heavy planers. A third circuit, primarily intended for driving machinery of this class, needs to be installed. This may be conveniently referred to as a "machine tool circuit."

Whether an iron working planer may be placed upon the machine tool circuit depends largely upon the size of the planer. The heavier machines, on account of the great momentary demands they frequently make for power, would be apt to produce sudden and considerable variations of pressure in the machine tool circuit. Better general operation of the entire plant can be obtained by placing them on the crane circuit. The smaller planers can safely be placed upon the machine tool circuit, thus obtaining more uniform motor speed for driving them, while not materially affecting the pressure in the latter circuit.

Certain classes of machine tools, including the emery grinder for finishing reamers, mandrels, and accurately formed machine parts, require a very constant speed for the production of well made pieces. A jerky speed, as of a line shaft forming part of a system on which are heavy metal working planers, causes the grinding wheel to cut deeply into the work in some places, thus making a well finished product impossible. Power for light machines of this type may be taken from the lighting circuit without detriment to its constant pressure. Desk fans, and even larger ones, can also be connected to the lighting circuit without harm.

On account of the great variation in the amount of power demanded by cranes and other classes of machinery already mentioned it was doubted whether all the circuits leading out through the works could be connected to the same bus bars in the power house without causing a fluctuation of pressure great enough at the bus bars to affect appreciably the constant brilliancy of the incandescent lamps placed in locations where the most steady light would be required. Just what would be the effect could not be predetermined. For this reason it was decided that the switch board should be so made and the generating machinery so divided into units that, if the amount of fluctuation caused in the incandescent lights should be too great when feeding all circuits from the same bus bars, the crane and heavy planer circuit could be thrown on to one generator, and the other machinery and lights fed by another generator. If, as was hardly supposed would be the case, even with this arrangement the incandescent lamps should not burn steadily enough, there would still remain the expedient of a separate generating unit for the lighting circuit. The supposition was that, even though such a separate lighting unit might be necessary at the times when the cranes would be performing their heaviest duty, which is while running off a heat in the foundry, there might be other considerable periods of time when the demands by the cranes would not be sufficient to affect the lights appreciably, even though all were operated from the same bus bars. Such being the case, the lighting unit would have to be operated a small part of the time.

Two Generating Units.—It seems advisable to install at least two generating units exactly alike, and to have one small unit which might be used for furnishing the current to run one or two machine tools, or even a small electric hoist or elevator, when there might be a demand for such service on account of making repairs, or operating some one or two machines on holidays, or in case of a breakdown. Such a unit to be driven independently of the main power plant, so that, even though the fires might be dead under the boilers, this extra unit could be operated. A unit consisting of a small generator driven by a water wheel, or by a gas or gasoline engine, would answer such a purpose. Two large units, running in parallel, for carrying the bulk of the load, or separately for dividing it between them in case the cranes and heavy planers would have to be driven separately from the other machinery, would give a desirable division of the power units for night work and when operating only a part of the plant. This would give an opportunity for repairing the generating units without hindering the running of the entire establishment. Direct connected units were selected as most suitable. While it is not believed that great multiplicity of generating units is desirable, it is thought certainly better to have at least two main units for the reason already stated.

A motor generator was decided upon as the best apparatus for balancing the two sides of the 3 wire circuit. In a plant where the installment of electrical machinery for power transmission goes on gradually the motor generator may be made of an ordinary commercial motor and generator. When the demand upon them becomes too great for their capacity they may be replaced by larger machines and used for motors in some part of the establishment. It was not thought that a storage battery would be as satisfactory for balancing the system as the motor generator.

Individual or Group Driving.—The question of individual driving, or group driving, of the machine tools naturally came up. The solution depended almost wholly upon the ability of arranging the tools for group driving, or the necessity of driving some individually on account of the location each should occupy in order that it might perform its special functions to the best advantage. As to what would be the most efficient limit for the smallness of motors for driving did not once come up. And the writer has been led to believe, by close examination of these two plants and the more general observations of many others, that, except for very light machinery, there is seldom any need of considering which would be the most efficient method of driving, group or individual; or what would be the smallest size of motor to be used for groups, the limit of subdivision being based upon considerations of efficient power transmission. Convenience of operation and the methods of securing the greatest amount of output from operating machinery are of so much greater moment in most cases than economy of driving in pounds of coal saved that the latter sinks into insignificance in comparison with the former. Where it is desirable to have a machine driven at a variable speed of such a nature that it can be obtained only by a corresponding variation of speed in the source of its power, then, in the general case, it is undoubtedly better to drive that machine individually by a variable speed motor, whatever the amount of power required for driving it. On the contrary, if there are a number of machines whose speed regulation can be satisfactorily secured through the ordinary mechanical connection with a uniformly rotating shaft, and they can be grouped together and still perform their functions to the best advantage, then unquestionably the best method of driving is to use, within the limits of convenient arrangement, as large a motor as possible.

The installation of small hoists suitable for serving machine tools, when the work handled is generally too large for one man to put in place, is one of the improvements in the modern machine shop which has worked much benefit and saved much time. When the work to be lifted varies in weight from 75 to 500 pounds it is believed that the pneumatic hoist is generally best for the porpose.

The conveying of materials and machinery from building to building and through the yards of a large establishment must needs be done, if done expeditiously, by some form of industrial railway. The form of locomotive most suitable for this purpose is not easy to decide upon. The horse hardly enters into consideration, and men are too expensive for the purpose. On account of the necessity of running through shops containing finished product and valuable machines, a steam locomotive cannot be used on account of the deleterious fumes thrown out, not to mention the fire risk. The compressed air locomotive appears to have proved more expensive than the electric for such purpose, and the choice seems to be guided toward the latter. Current can be furnished for the electric locomotive most conveniently and economically by the overhead trolley system outside of the buildings and wherever else trolley wires can be erected. In most places inside the buildings, however, the trolley cannot be used, so some other means must be obtained for furnishing current to the locomotive. There seem to be two merits that merit consideration—namely, by the storage battery and by the contact system of a shoe underneath the locomotive rubbing against contact points placed alongside or between the tracks. The writer is in doubt as to which would be the more suitable.

Cranes.—While watching the operations of electric traveling cranes, frequently when in the cage with the operator, the writer has always

been impressed with the need of fewer levers for controlling the different motions. In a traveling crane with a single hoist there are three controllers, each with its individual lever; one for the motion of the bridge along the stationary track on which the entire crane runs, one for the traverse of the trolley across the bridge, and a third for hoisting and lowering a load. If the crane has an auxiliary hoist, which is very common in practice where two are needed, then a fourth controller and lever are added. On account of the necessity of quickly grasping and moving one lever after another, the operator is apt to heave them more quickly and further than is necessary, thus throwing on a sudden heavy current, which strains and racks the machinery. This is the usual occurrence when quick time must be made.

It would not be a difficult or expensive task to have, for a single hoist traveling crane, one lever to control any one of the three motions and another to control the remaining two motions. One lever could control the bridge travel and the other both the hoisting and trolley traverse, the hoisting by moving the lever in a vertical plane and the trolley traverse by moving it horizontally. A combination of these two motions of this lever would control both the hoist and traverse at the same instant.

For a crane having a main and an auxiliary hoist, each of two levers could control two motions. One could control the main hoist and traverse, and the other the auxiliary hoist and bridge travel. By such a method of two-lever control the saving of time and machinery would amply repay the extra expenditure necessary for suitably arranged controller levers, the additional cost of which need not be very great.

Power Required.—Indicator cards were taken from the five engines furnishing power for the mechanical driving system of one of the plants. These cards were taken at the time when the load upon each engine was at the maximum value that it was found to reach during a period of half an hour to an hour. The aggregate indicated power for mechanical driving thus obtained amounted to something over 500-horse power. Cards were taken from the same engines in order to find the power necessary to drive the line shafting, countershafts, jackshafts and all other apparatus which ordinarily ran when no operating machine or crane was at work. It was found that this frictional horse power was considerably over one-third of the amount found by taking the maximum for each engine, as stated above, when operating the machinery. Cards taken covering a considerable period of time show that in each case the power required of the engine was much less as an average from morning till night than obtained for the maximum load. While no actual calculations were made to determine the ratio of the frictional horse power to that for this average load, it was very clearly shown that the indicated horse power of the engine for average load was only about twice that for friction. Each engine drove its own system independently of the other engines. Other engines were used for generating currents for the electric cranes and a few electrically driven machines and sections of line shafting.

While the results of tests upon several electric motors convinced the writer that as high a degree of economy as is often set forth for such machinery could probably not be obtained in a commercial machine built to withstand heavy loads and rough service, he was certainly convinced that a great saving of the power wasted on friction in the mechanical transmission system could be saved by electric driving. It was found that electric motors, manufactured by well known concerns who make the best of apparatus, required, for a 10-horse power motor, about 1 electrical horse power to run it without load, there being no belt upon the pulley, and when the only frictional resistance to be overcome was at the journals and brushes. The latter were adjusted to bear lightly against the commutator, which was smooth and otherwise in good condition. Under the same conditions a 20-horse power motor required aboue 1.5-horse power to drive it light, and a 25 horse power motor required at one time 1.75-horse power, but later, after the commutator had become slightly roughened by heavy overloading, it took fully 2 horse power to run it light. Several other motors, of sizes ranging from 7.5-horse power to 50-horse power, showed similar demands for power to run them light. The motors were the products of several different manufacturers. The instruments used for taking the readings of current and pressure were of the Weston portable type, and were calibrated at the Weston factory during the test.

On one motor of 20-horse power capacity it was noticed that the speed kept gradually increasing for some time after starting, until it became 5 per cent. or more greater than at first, although the line voltage and load remained constant, and no adjustment was made on any part of the motor or its attachments. The increase took place when the motor was completely left alone. After an hour or two the increase ceased, and the speed remained constant. The speeding up was probably due to weakening of the field magnets caused by the gradual heating of the field coils, and the reduction of field current by the increased resistance of the field circuit on account of its heating. Such an increase of speed was not noticed on other motors.

Although the writer has just stated what might, by mistake, be taken as objections offered by him to the use of direct current machinery, and might give opportunity to set forth the great advantages of synchronous and induction motors, which, on account of the absence of commutators and even collector rings in the latter type, do away with all the frictional commutator resistance, and, in addition, afford the utmost simplicity of construction, he wishes to affirm that he nevertheless believes the direct current machinery to be by far the most suitable for such cases as those in hand, although, on the other hand, he believes that there are many cases, especially when a uniform rate of speed is essential without speed variation governed by a controller between fixed limits, where alternating machinery is the one by far the most suitable. While we often hear of the faults and frailties of direct current machinery, it must not be forgotten that the direct current generator and motor were the pioneers in the field of the commercial application of electricity to lighting and power transmission, and that the tales of woe, true of the early machines, have a tendency to cling unjustly to the more modern direct current machinery, although it has been so improved as to free it from practically all the faults of its younger days and to make it as reliable and durable as the steam engine. Neither should it be forgotten that the alternating, and especially the polyphase, machinery, coming on at a later date, had advantage of all the knowledge gained through some years of costly experience with direct current machinery, and therefore does not have hanging around it any of the disagreeable reminiscences that are apt to follow the latter.

One great advantage of electric power transmission in the machine shop is that of having a means of furnishing power to portable machine tools, either large or small, at any part of the works where suitable circuits are run. It is such a strong point in favor of electrical transmission that it deserves being ever kept before the minds of those who have to do with machine shop and factory. The time that can be saved and the greater accuracy of work that can be secured upon many kinds of large machine members, by setting them upon a machined plane surface floor with slots and holes for inserting bolts to clamp them down, and then bringing portable machine tools to them with the crane, railway or truck, each to perform its own special operation, makes this method of procedure worthy of consideration by the manufacturer and builder of heavy machinery. The heavy casting can be set upon a flat metallic floor almost invariably more quickly than it can be set before any machine tool occupying a fixed location, and made ready for the tool to operate upon it. If the casting requires the operations of several kinds of machine tools, it must be set again and again, as many times as there are permanently located machines required to do the work. To set a portable machine tool with a plane machined base upon a level iron floor and bring into position for working upon a casting also upon the floor, occupies but a fraction of the time necestary for setting the casting in position for a permanent machine tool. Moreover, several portable machines may be brought into action upon one casting at the same time. This is seldom true of machines fixed in location.

The Highest Chimney in the World.

Experience has shown that the proper height of factory chimneys is not alone dependent on the quantity of smoke and poisonous gases to be carried off by them. It is essential that a chimney, especially when its main function is to remove poisonous or otherwise deleterious products of combustion, should be constructed to such a height that the escaping gases may cause no harm. This of course is so particularly at chemical factories and gas works, where often the poisonous and dangerous products of combustion escape before they enter the flue, thus demanding costly constructions which are often found extremely difficult to carry out.

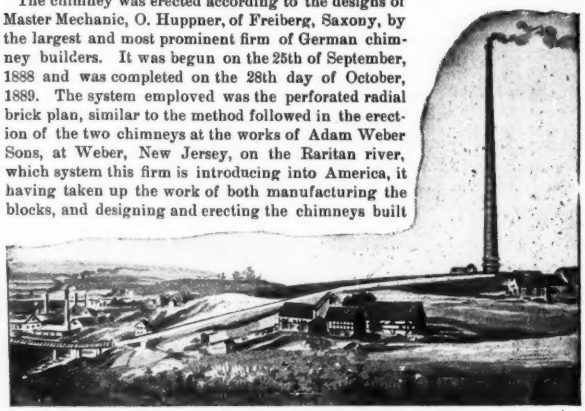
The experience of to-day goes to show that an outlet height of about 300 feet above the level is considered sufficient to prevent harmful action to plant life, as well as any interference with the health of people living in the vicinity of the chimney. Should this territory be surrounded with wooded heights it is well to increase in the same ratio the height of the chimney. In rolling or hilly country the outlet of the chimney should be placed at least 300 feet above the highest point of the surrounding hills. A chimney in the valley would, in consequence of this great height, cost so much that it would be cheaper to build the flue of the chimney on the highest point, and erect the

chimney proper on the existing higher plane afforded by Nature. On account of this aforesaid condition, the Royal Saxon Smelting Works, at Halsbrucke, in Freiberg, were compelled to build a high chimney, which can safely be considered the highest and most prominent chimney of this century. This chimney has a height above the surrounding plane of 459 feet. The height of the chimney itself is 429 feet 6 inches, the square base being 29 feet 6 inches, and, therefore, at the time of its completion, in 1889, it was the highest chimney in the world. The internal top diameter is over 8 feet. As this enormous height did not afford sufficient security for the surrounding neighborhood against the outgoing gases, this chimney was erected upon one of the adjoining highest hills, which is 197 feet higher than the smelting works situated in the valley. In consequence of this position the chimney obtains an additional height, and an increased efficiency equivalent to an altitude of over 656 feet.

As this chimney, on account of the noted reasons, could not be placed next to the factory, but was built upon the highest hill, a flue, of over 1,640 feet, was constructed, which runs part of the distance over a bridge, specially built to hold the construction, over the river Mulde, which separates the factory from the hill upon which the chimney is built, thereby reducing to a rational amount the cost of the construction, the outlet of said chimney being about 300 feet above the adjoining plane.

Notwithstanding the great saving by the construction of the flue, and utilizing nature for the additional height, the chimney alone cost over $31,000 and the construction of the 1,640 feet of flue $25,000; hence the total cost is about $56,000, including excavations, foundations and the necessary iron rings; the two latter costing about $2,620. Even this tremendous cost has been a good investment so far, for the Company has not been compelled to pay any damages to the surrounding property holders since the erection of the big chimney, whereas theretofore divers claims had to be satisfied to the extent of 40 per cent. according to governmental decisions.

The chimney was erected according to the designs of Master Mechanic, O. Huppner, of Freiberg, Saxony, by the largest and most prominent firm of German chimney builders. It was begun on the 25th of September, 1888 and was completed on the 28th day of October, 1889. The system employed was the perforated radial brick plan, similar to the method followed in the erection of the two chimneys at the works of Adam Weber Sons, at Weber, New Jersey, on the Raritan river, which system this firm is introducing into America, it having taken up the work of both manufacturing the blocks, and designing and erecting the chimneys built



Royal Saxon Smelting Works, Freiburg.

of such blocks. The blocks used are made of a very highly refractory and smooth clay, entirely free from small stones and pebbles, and which, when burned at a temperature of about 2,000° F., become almost impervious to water. They are also of large face, thus presenting fewer joints to the weather and to the action of the gases. Judging by results and the imperative demands in this line, it will not be long before America will surpass this big construction with a still "taller" chimney.

The following data will be of interest showing the magnitude of the Freiberg construction. Its base lies 10 feet under the level, and is 39 feet 3 inches square, covering an area of 1,550 square feet. The following quantity of material was used, viz: 13,883 cubic feet for foundation work; 17,736 cubic feet for pedestal; 63,666 cubic feet for the column, giving a total of 95,285 cubic feet of mason work.

The mason work had a special weight of 124.8 pounds per cubic foot—the entire lot to be carried was 5,308¾ gross tons; and the weight to be sustained by the foundations is increased to 4¾ tons per square foot.

There is no doubt that this chimney, with all its details and peculiarities, is one of the greatest works ever erected in this particular line, and is accepted to-day, by the official organs of Germany, as a standard of chimney construction.

[*Journal of Gas Lighting.*]

Professor Lunge on Coal Tar and Ammonia.[1]—No. II.

The present edition of Professor Lunge's work contains 248 pages, with 84 illustrations, dealing with ammonia, against 194 pages, with 53 illustrations, in the 1887 edition. This substantial increase in bulk is fairly uniformly distributed over the various chapters, which now number four, as compared with three in the earlier edition, owing to two chapters being now devoted to the working up of liquor, in place of one.

The sources from which ammonia is obtained are discussed at greater length than formerly; and there is a slight re-arrangement of the sections of the chapter which deals with them. From a practical point of view, it would have been better to speak of many of the sources referred to as potential rather than as actual sources. They are classed under ten groups, of which several are practically unimportant. The first refers to the natural occurrence of ammonia—*e. g.*, in the air in minute traces, in guano deposits as bicarbonate, in the Tuscan *suffioni* and lagoons, in the neighborhood of volcanoes, and in a few minerals. Considerable quantities of sulphate of ammonia are said to come from Tuscany as a bye-product in the manufacture of boric acid. The second group comprises ammonia formed from atmospheric nitrogen. The pages of Professor Lunge's work which refer thereto read like a catalogue of inventions which have failed; for the conversion of atmospheric nitrogen into ammonia has always proved a most fascinating exercise for inventors, although few schemes have even passed beyond the laboratory stage. Nor, so long as we have a store of nitrogenous bodies, derived from the atmospheres of bygone ages, in our deposits of coal and peat, does it seem likely that a process for artificially producing ammonia from atmospheric nitrogen will prove a commercial success.

The third group covers the ammonia formed in inorganic chemical manufactures; and Professor Lunge concludes that none of the processes classed in it are likely to be remunerative under present circumstances. Then he deals with ammonia from animal excreta, etc., which form a perfectly practicable source in cases where they can be collected without dilution. It seems that in Paris, Amsterdam, and some other Continental towns schemes for collecting and treating excreta for the production of ammonia, have been adopted; but apparently the amount of ammonia recovered from such sources is not known precisely. The fifth source is guano. This, apart from any ammonium bicarbonate present which was included in the first group, may be treated for the production of ammonia salts, which, however, would have a lower manurial value than the guano itself. Hence this source is practically useless. The next group comprises ammonia from bones, horn, and other animal substances, which are generally used for the manufacture, primarily, of bone charcoal or prussiate, and ammonia is recovered only in some cases as a bye-product. Professor Lunge does not estimate the amount obtained from this source. The next group relates only to ammonia as a bye-product in beetroot sugar factories. The amount so obtained appears at present to be small. Professor Lunge computes that if all the beetroot sugar works in Germany recovered the total ammonia given off, it would yield 15,000 tons of sulphate. Most of it is now lost. During the last few years, however, the endeavor has been rather to produce cyanides from the molasse liquors in place of ammonia.

The last three groups really cover the sources from which the bulk of ammonia products are obtained, or are likely to be obtained in the immediate future. The first of these three comprises peat; but it does not appear that much ammonia is at present obtained from this source. The second comprises shales; and the amount of sulphate actually obtained from the Scotch shale distilleries has been from 37,000 to 38,000 tons for each year from 1895 to 1899. From this, the second largest source of ammonia products, Professor Lunge passes on to the last group, which includes ammonia obtained from coal, (1) in the manufacture of gas, (2) by treatment with steam, (3) from coke ovens, (4) from blast furnaces, (5) from producer gas, or (6) from ordinary coal smoke. Gas manufacture, of course, continues to be the chief source of ammonia products in this country. We confess that we are somewhat at a loss to understand what grounds Professor Lunge has for for writing as follows:

1. "Coal Tar and Ammonia." Third and Enlarged Edition. By George Lunge, Ph.D., Professor of Technical Chemistry in the Federal Polytechnicum, Zurich. London: Gurney and Jackson, 1900.

Since the great bulk of the ammonia compounds is obtained as a bye-product in the manufacture of gas, and the latter is unlikely to be more extensively employed than it is at present, the question must necessarily arise—what will be the state of things if the demand for ammonia should exceed the supply?

Why does he believe that the use of gas will not continue to extend? He does not tell us; and it is certain that everything points to a steady and by no means insignificant increase in the employment of gas. Surely Professor Lunge had not studied the statistics of the gas industry for the last few years when he wrote thus of its future.

A good many new data on the distribution of the nitrogen of coal on carbonization have been introduced since the last edition; but most of them will be familiar to readers of the *Journal*. Professor Lunge does not appear to have taken the trouble to ascertain the extent to which Cooper's coal liming process is now used; for he says, as he said in the 1887 edition:

Only a few gas works introduced Cooper's process; and according to information received by the author from highly trustworthy sources in 1886, there was but little prospect of its more general adoption, as the extra yield of ammonia is counterbalanced by several drawbacks.

We believe he could have satisfied himself without much difficulty that the drawbacks have led to the process being discarded at nearly all the works at which it was tried. In fact, so far as we are aware, it is now used in this country only at Folkestone. We are sorry to see that spent oxide is still regarded as a practicable source of ammonia, as it is evident that it cannot be so if efficient scrubbing of the gas is practiced.

Coke ovens constitute an important source of ammonia, especially in Germany, where 42 per cent. of the coke produced is obtained from ovens provided with ammonia recovery plant. The yield of sulphate from the German coke ovens is now estimated at 84,000 tons per annum. In Great Britain, however, though it is estimated that 35 million tons of coal are carbonized in coke ovens, ammonia is recovered from only 1,100,000 tons; and the yield of sulphate is therefore only about 11,000 tons. Perhaps it is well for the gas industry that it is so; but there can be no doubt that the more economical German practices in the coking of coal are now being adopted here to an increasing extent. Fortunately, however, the demand for sulphate for manurial purposes is likely, according to Professor Lunge, to increase at as great a rate as its production. Much more of such nitrogenous fertilizers can be applied as the conditions of rational agriculture are better understood. The prospect does not therefore seem disheartening to gas managers, even though the gas works production of sulphate be eventually surpassed in this country—as it has been in Germany—by that of the coke ovens and blast furnaces. The recovery of ammonia from ordinary coal smoke is, of course, at present out of the question, though Prof. Lunge gives, for what it is worth, a statement by Prof. W. Foster that he found 11.55 per cent. of ammonium sulphate in the soot from a coal fire!

The chapter on the "Composition and Analysis of Ammoniacal Liquor" has been adequately revised for the present edition; but naturally it did not require the extensive changes which were needed in other parts of the book.

In the next chapter, on "The Working Up of Ammoniacal Liquor," a great deal of new matter has been introduced on the manufacture of "concentrated gas liquor," of pure liquor ammoniæ, and of anhydrous liquid ammonia. Concentrated gas liquor is largely produced at German gas works, and contains 15 to 20 per cent. total ammonia. It is consumed in large quantities in the manufacture of ammonia soda. With regard to pure liquor ammoniæ, Prof. Lunge says that its manufacture is "the most difficult, but the most remunerative, way of dealing with gas liquor, and is practiced on a very large scale; the demand for this article for cold producing machines being very great." The processes and apparatus for the manufacture of both concentrated gas liquor and liquor ammoniæ are fully described; and gas managers who have to work up liquor might profitably consult this portion of Prof. Lunge's work before they decide to continue to make sulphate only. But it is doubtful if it is fair to expect any gas manager to master more than one process of dealing with gas liquor, and especially such an operation as that of the manufacture of pure liquor ammoniæ. Such processes always require close supervision of a manager skilled in them; and the gas engineer will find, as a rule, more profitable employment in his more legitimate avocations. If he is asked to undertake the manufacture of liquor ammoniæ in place of sulphate, we would recommend him to secure a skilled subordinate, to whom he could depute the task of supervising the working of the new process. With regard to the manufacture of sulphate, the information contained in the second edition is now somewhat amplified. We are inclined to think that Prof. Lunge credits, to a far greater extent than is actually the case, English sulphate works with continuing to use apparatus which has become obsolete. His observations on the avoidance of nuisance from sulphate works are well worth reading by anyone in charge of such works, notwithstanding the beneficent supervision exercised in this country by the Alkali Inspectors.

The last chapter in the book is a short one on "Other Technically Important Ammonium Salts." It also deals with the estimation of ammonia. There is nothing here that calls for special comment. Then follows an appendix, giving some useful tables, and the inevitable *addenda*, which are fewer in this than in the second edition. The index brings up the present volume to 929 pages.

The work, of course, is a *sine quâ non* to all engaged in tar distilling or in the working up of gas liquor; and every gas manager will find it a useful reference volume. We are disposed to think, however, that the great bulk (and high price) of the present edition indicates that it would have been better to have issued it in two parts—one on Coal Tar and one on Ammonia—so that those interested in one of the products only need not necessarily have been burdened with a lengthy treatise on the other.

(Concluded from Page 972.)

The Influences Exerted by Power Factor.

By Mr. F. H. Leonard, Jr.

The induction motor being complete in itself, requiring no exciter, starting motor or clutches, and furthermore, being automatic in its regulation without any special appliances, free from commutators or brushes, is simplicity itself; its essential features consisting of a stationary primary and a rotating secondary in large sizes when well designed has a power factor at full load of .94 or better, regulates well under sudden fluctuations of load without reflecting seriously on the line and generator, but in fact actually tending to assist the regulation of the line. A load thrown suddenly onto an induction motor immediately increases its power factor and helps the regulation of the generator supplying this sudden demand for current. As the power factor of the induction motor is low at light load, it follows that a sudden reduction of the load at once lowers the power factor of the motor, calling for lagging currents in the line, replacing by inductive drop the ohmic drop of the work current of the moment before the armature reactions in the generator tending to demagnetize its field and prevent increased electromotive force, which would otherwise result when load is thrown off. For varying loads and for operating incandescent lamps in connection with a power circuit, under the ordinary commercial conditions, the preference is altogether in favor of a well designed induction motor. With a secondary consisting of copper bars secured to short circulating rings at both ends, insulation is never troublesome, and in fact may be omitted entirely. It rotates without electrical contacts or connections inside the stationary primary element which can be safely insulated for all ordinary voltages, and in the larger sizes connecting the 2,000 volts pressure directly to the motor terminals. In the small sizes it is of course advisable to use transformers to reduce the pressure to 500 volts or less where subject to careless handling. Having once become familiar with them, you would never think of using direct current motors with their troublesome commutators and brushes and expensive repair accounts. Intelligent selection of the size of an induction motor for the work it has to do has a very important influence on the power factor of the line, and it should not run with an average load much below its rated capacity. It is much better to select the motor which, being loaded to its rated capacity, or nearly so, operates with a high power factor and can be overloaded for short intervals to the extent of 25 per cent. of its capacity without doing any harm; as there are no delicate parts to this type of machine, nor any moving insulated wires, they will stand a much higher temperature without deterioration than the equivalent direct current motor. Induction motors are also designed for variable speed, many now being used for crane work and other uses calling for variable speed and torque, but in this class of work they are hardly equal to the direct current series motor, and unless very expensively designed, operate with low efficiency and power factor, though where non-inductive resistance is used for control the power factor may be improved at the expense of efficiency.

Arc lamps have been until recently operated from direct current series dynamos, though the first important arc lamp installation used in the city of London, England, the Jablochkoff candles, as they were

called, were operated by alternating current dynamos. Several years ago the direct current incandescent companies realized the advantage of being able to supply arc lamps from their incandescent circuits and adopted the direct current incandescent open arcs. These were soon followed by the inclosed arcs, which, operating at a higher voltage, admitted of individual control without excessive waste in the large resistance required with the open arcs. Besides this, a great saving was realized in the amount of carbon burned, the inner globes preventing access of oxygen which rapidly disintegrates and causes the carbons to waste away. By no means the least saving which followed was the reduced labor, one man easily trimming six times as many inclosed arcs as he could of the open arcs, as they required attention once in several days instead of daily trimming.

From the direct current inclosed arc it was but a step to the alternating current inclosed arc with resistance in series, or with auto transformers or choke coils on commercial alternating current incandescent circuits. It was found, however, that the alternating current arcs operated to reduce the power factor of lines with which they were connected, depending on the regulating device used in connection with them, it being practically impossible to obtain a satisfactory light without some regulating arrangement, though sometimes sufficient choking effect is produced by the feed regulating magnets. All such regulating arrangements reduce the power factor except the resistance method; but the resistance, while improving the power factor, wastes true energy and reduces the efficiency, while the inductive regulators only increase the apparent energy or wattless currents.

The advantage of operating arc and incandescent lamps from the same dynamo simplifies the central station equipment and admits of the use of a single type of dynamo for all purposes of higher efficiency, interchangeable parts, one type of reserve apparatus, and easier switchboard control. Some of the best inventive talent on the Continent has recently been employed upon devices to enable the central station management to rid themselves of the direct current series arc dynamos, which at best occupy much floor space for their output and have a maximum efficiency of 75 to 80 per cent. as against an efficiency of 90 to 97 per cent. in large, modern alternating current dynamos which occupy the minimum floor space per unit of output at much lower first cost. For alternating current street lighting with lamps in series, one device has followed another till we now have an almost bewildering variety, each device having its superior points, making the choice more difficult.

The constant current transformer operating a string of arcs is almost perfectly automatic, provided the load is not too much reduced and can be tapped on to any part of the line to economize wire, the device itself being located in a small sub-station which may consist of an under ground vault, as inspection and adjustment are not frequently necessary. This arrangement has a very fair power factor at full load, but the power factor is low when partly loaded. A device operating on the choke coil principle has all the advantages named in connection with the first arrangement. The amount of choking effect is regulated by the number of lights which is desired to compensate for. If a small percentage of regulation is required, a small regulator at low first cost is sufficient, and at full load the power factor is high, the inductive effect depending almost entirely upon the lamps themselves. Another arrangement has been designed on the principle of the constant potential transformer with loops taken out to automatically vary the voltage as lamps are turned off or on. The power factor is good and rather better at light load than the others, but such a regulator should be kept in the central station, or in a sub station when it has the advantage of an intelligent attendant.

Besides devices of the above types, individual transformers may be used, but their high first cost and the fact that each lamp must be turned on and off individually instead of in groups as with the previously mentioned apparatus, makes their use impractical for street lighting except under special circumstances.

In some notable cases where central stations are using power transmitted from a distance, induction or synchronous motors have been coupled direct to direct current arc dynamos; this would be the ideal place to use a synchronous motor immediately under control of the central station if the induction motor load occurred at the same time, but unfortunately they occur at different periods and we can see no reason for using the synchronous motor, as the induction motor is self-starting and requires no separate excitation. In any case the motor driven arc dynamos are out of the question except where the frequency is too low for satisfactory arc lighting. Arc lamps are very unsatisfactory on 25 cycles and their effect at least unpleasant unless the frequency is in excess of 35 or 40 cycles. With a mixed lighting and motor load there should be no difficulty in getting a line power factor of .90, and with load consisting mainly of motors .86 to .85. I have in mind a case where about 3,000-horse power, in motors ranging from fan motors to motors of 500-horse power, are used, and recently measurements showed a power factor of about .90, the percentage of incandescent lamps on the circuit being almost inappreciable.

A power factor of .80 at full load would be disastrous to the regulation of the old style single phase dynamo; no amount of excitation would enable them to hold the voltage on the line. Though many will no doubt recollect seeing at the World's Fair at Chicago in 1893, the then monster 2 phase dynamos, which were but 2 large alternators with armature mechanically coupled together so as to give the proper phase displacement to the two independent circuits. Some Canadian water power stations which have not yet installed polyphase apparatus having 2 single phase alternators, might adopt this expedient for obtaining 2 phase currents to start a power circuit. With ample water power, the added expense, for a day circuit would not amount to much, probably little more than the cost of an additional attendant which would easily be covered by a contract for furnishing power to some manufacturing establishment, or perhaps pumping water for the city and neighboring villages. The power business once started would grow rapidly and become an important source of revenue. Few realize the extent to which the power business is destined to grow. The old style alternator will stand a moderate amount of motor load mixed with lighting load, but when the motor load becomes a large percentage of the total load, the old dynamos which perhaps were admirably adapted for supplying incandescent lights will no longer be suitable. The growth of the motor business has called for radical changes in the design of alternators. Machines which on short circuit would give double full load current were the rule, and this was even urged as a distinct advantage in such an emergency. For motor work, the inherent regulation indicated by a short circuit current of at least 3 or 4 times full load current is demanded, and a change of excitation with full load current and .80 power factor not exceeding 15 or 20 per cent. and capacity for 25 per cent. more than normal full load current for 6 hours without dangerous heating, or 50 per cent. more than full load current for 1 hour, which means a very superior dynamo.

This state of perfection having been reached through gradual evolutions resulting from the difficulty of maintaining regulation with motor loads and lagging currents, which tend to demagnetize the fields and lower the voltage, the lagging currents call for increased capacity in the dynamo line and transformers, which supply current to the phase displacing devices, though the power is not increased beyond the small amount necessary to supply the I. R. losses in the copper. This calls for increased investment to cover the first cost of the improved dynamo transformer and added copper, though notwithstanding the advance in raw materials, the very superior dynamos of to day cost no more than the dynamos of a few years ago, and not so much per kilowatt as we were obliged to pay ten years ago for the old single phase dynamos. In all classes of business it is poor policy to attempt to save on the first cost of a plant by buying machinery which is out of date. This is particularly the case in making an investment in electrical apparatus, the design of which has been undergoing such active gymnastics in the past ten years. We must look well into the future and anticipate the growth of the power business, which already bids fair to outstrip the lighting, and get only the best apparatus well up to date in every particular. The apparatus made by the leading electrical manufacturers on intelligent specifications more nearly approaches perfection than any other power translating device, notwithstanding the comparative youth of the art. What engine or water wheel builder would for a moment consider a specification calling for 96 per cent. efficiency? Yet electrical manufacturers for the larger sizes of dynamos will guarantee even better than such efficiencies.

With these high attainments it is hard to conceive of any material improvement in electrical apparatus, and we shall probably see little more of the changes once so frequent where entire plants were consigned to the scrap heap because it was cheaper to buy new than to continue for a short time the operation of the old, the difference being sufficient to turn the balance between success or failure of the enterprise. Already the process of standardization of things electrical has set in, and we may look for changes in the future tending to a reduction to well recognized standards in construction of apparatus and central station practice rather than to startling improvements in design.

Power factor, which at one time was the great bugaboo of the electric central station, is now being rationally met and provided for in the equipment of power houses as a necessary evil and one of the in-

cidental expenses of a new branch of the business, which adds materially to the income of the plant and enables the hard working manager and superintendent to please his stockholders with increased dividends.

The Electrical Outlook in Siam.

Mr. Hamilton King our Consul General at Bangkok, Siam, has sent the following report to the Department of State:

"The three companies that import electrical supplies report that their business has more than doubled during the last 12 months, while to my personal knowledge their orders during the last 2 months have exceeded those of any 12 previous months. There is a large and rapidly increasing business along this line in Bangkok, Siam, and there is no reason why the United States should not get a generous share. The tendency is toward the American market.

"The orders for the entire supplies for the new tramway, during the last 2 months, have been placed in the United States, with the exception of the rails. The order for the rails went to England, because the company thought they were unable to secure the peculiar kind they wished in any other country. This however, I believe is largely due to want of information on the subject, a cause which more familiar acquaintance with our manufacturers will no doubt set aside.

"A large quantity of the American electrical goods used here comes through London and European houses. This is another obstacle that can be removed by our manufacturers placing themselves in direct communication with importers here. American goods are in favor and the prices suit. The importers complain of American lack of promptness in attention to business. While goods are delivered here in 3 months from the time they are ordered from Europe and England, 7 or 8 months, and sometimes more, are consumed in getting them from the United States. This delay should be remedied. It is within my knowledge that answers to important cables have been delayed a full month.

"I quote from a letter just received at this office from one of the leading importers of this city:

"'My experience in doing business with the United States for the last ten years is that generally, in the United States you get for the same money a better article than in most European countries; but, with a few exceptions, American firms are not prepared for business with distant countries. Some of them have not even a cable address, and nearly all are slow and unsystematic in their correspondence. Shipping arrangements to Siam are also defective, as much as four or five months sometimes elapsing between shipments from New York, whence we get most of our goods, and arrival in Bangkok. In consequence, we often prefer to order dearer or inferior articles from Europe to avoid delay and uncertainty.'

"The packing of the goods, I am pleased to report, has been materially improved during the last year. While one lot has come in a most unfortunate condition, yet the importers on the whole report satisfaction in this line now. It is to be hoped that the improved condition of shipping with all the far East that will come with our more direct communication with the Philippines will remedy some of these difficulties; and this, together with attention on the part of our manufacturers to those points to which reference has already been made in this article, will put America in possession of her share of this trade in Siam.

"The leading importers of electrical supplies in this city are the Siam Electricity Company, Limited, the Siam American Trading Company and the Bangkok Dock Company."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE contract for rebuilding the gas works at Newton, N. J., has been awarded. The present Van Syckel water gas process in use will be replaced by a modern double superheater, Lowe water gas system, to be constructed by the United Gas Improvement Company. The capacity of the new plant will be about 125,000 cubic feet per day.

MR. E. G. HOLZER, Superintendent of the Easton, Pa., Company, is very much pleased over the rejuvenation of his large holder, which has had much repairing done to it. The repairs included a new crown, and a new 12-inch outlet was placed. This will put him quite up to the exacting delivery and pressure demands during the holiday season. That he was uneasy while the holder was out of commission, will be readily understood, when it is said that for 9 weeks the available holder capacity was something like 33 per cent. of the daily output.

ARTICLES announcing the incorporation of the Citizens Gas and Electric Light Company, of Council Bluffs, Iowa, have been filed by Messrs. Clifford W. Perkins, Evan J. Dudley, Louis B. Dailey, Kenneth K. McLaren and L. A. Rapelyea. The main offices of the concern are to be in Jersey City, N. J.

AT the annual meeting of the Columbia (Pa.) Gas Company, the following officers were elected: Board of Managers, H. M. North, H. F. Bruner, M S. Shuman, Wm. B. Given, W. H. Shenberger and Joseph Janson; President, James A. Myers.

MESSRS. GEORGE MCLEAN and F. B. Harriman, and others of Dubuque, Iowa, have secured complete control of the gas and electric lighting properties of Waterloo, Iowa. They propose to rebuild the gas works next spring, the plant to be constructed on coal gas making lines. Mr. McLean is far from being a novice in gas trading, for he has actively and capably served for some years the Key City Gas Company, of Dubuque, Iowa, as Secretary and Superintendent. Waterloo is a brisk, busy place, with a population of 12,580, according to the last United States census.

MR. Y. WATANABE, architect, Imperial Japanese Navy, has contracted with the American Bridge Company for the steel work for a foundry and a gun and mounting shop for the Kure Arsenal. The American Bridge Company is also furnishing steel work for the forge shop for the Kure Arsenal.

THE proprietors of the Peoria (Ills.) Gas and Electric Company have certified to the Secretary of State that an increase in the capital stock of the concern, from $500,000 to $1,000,000, has been agreed to. This evidently means that active opposition between the gas and electric lighting interests is at an end. The contest at Peoria, like most disputes of the sort, was an unprofitable one for those engaged in it. However, we suppose all's well that ends well.

THE Brooklyn *Eagle* of recent date, in a news squib from Sag Harbor, L. I., says that the Trustees of that village have entered into a contract with the United Gas Improvement Company, which operates the Sag Harbor gas works, to light the streets by means of Welsbach lamps. The squib further says that the local electric light Company failed to furnish satisfactory street lights according to the terms of its franchise, and on the 10th inst. shut down the plant entirely. The final prediction of the *Eagle* is that the electric concern is about to go into bankruptcy.

MR. JOHN D. REYNOLDS, Superintendent of the Consolidated Natural Gas Company, of Pennsylvania, died at his home in Kittanning, Pa., the morning of the 9th inst.

MESSRS. LIDDON FLICK and Theodore Barber, of Wilkes-Barre, Pa., who have secured a controlling interest in the Muskegon (Mich.) Gas Light Company, assert that they will expend $25,000 next spring, on plant betterment and main extension, in the place named.

COL. FRANK S. RICHARDSON, of the North Adams (Mass.) Company, will make important plant betterments the coming season. A notable item in the list is a new generating house.

THE New Brunswick (N. J.) Light, Heat and Power Company, the lessee of the Gas Light Company of New Brunswick, elected the following officers at its annual meeting, held in New Brunswick about a fortnight ago: President, John C. Eisele; Secretary, Halsey M. Barrett; Treasurer, Nathaniel King. All are residents of Newark, N. J. The officers of the Gas Light Company of New Brunswick are: President, J. Bayard Fitzpatrick; Secretary, John C. Eisele; Treasurer, Lafferd Totten.

MR. F. T. RANSOM, of Washington, D. C., writing to the JOURNAL under date of Dec. 15th, says he notes in our issue for last week an item to the effect that the offer by a Philadelphia syndicate for control in the New Orleans (La.) Gas Light Company seems to meet with favor by the owners of the latter. Mr. Ransom adds, "You have according to my way of thinking been sadly misinformed. I may, and do further say that certain stock which I indirectly represent will never submit to a proposition so ridiculous as that put out by the Philadelphia syndicate." Of course we do not know what will be finally done in the premises, but we do know that the following late reference to the affair appeared in the New Orleans *Picayune*, dated the 13th inst.:

"The deal for the lease of the New Orleans Gas Company by the Philadelphia Company, headed by H. H. Pearson, seems practically

assured. Eight of the largest shareholders owning a majority of the stock, have signed an agreement and recommended the others to do so. This was done yesterday. The circular setting forth the fact was given out, and is as follows:

"'NEW ORLEANS, Dec. 3, 1900.

"'Confidential: This is to certify that the undersigned stockholders of the New Orleans Gas Light Company have signed and agreed to the contract of lease of the Company's plant until March 1, 1925, and of agreement of sale of stock at $125 per share, proposed by H. H. Pearson, Jr., and heartily recommended that all the stockholders do likewise. Such contract insures a larger dividend, namely, 6 per cent., than is now earned, an enlargement and betterment of the plant without risk, either to the Company or the stockholders, and an avoidance of any contingency of paying our floating debt by the execution of any mortgage, or the increase of the capital stock, which otherwise might be necessary. The contract is ready for signature at the office of the United States Safe Deposit and Savings Bank, No. 217 Camp street. It was prepared by Messrs. Farrar, Jonas & Kruttschnitt, attorneys for the lessee, and approved by Messrs. Buck, Walshe & Buck, attorneys for the New Orleans Gas Light Company. None of the stockholders of the Company who sign this recommendation, and as far as we know no stockholders of the Company, is associated with Mr. Pearson, directly or indirectly, in his proposal. Signed: A. Baldwin, A. B. Wheeler, Frank T. Howard, Douglas Kilpatrick, A. H. Siewerd, R. M. O'Brien, James Jackson, Alden McLellan.' The proposition of the Philadelphia Company is to take the entire property and franchise of the old Company and run it, making large improvements and guaranteeing 6 per cent. on the stock. They agree to assume all the indebtedness of the old Company and those which have been amalgamated with it. The promoters of the scheme reserve the right to purchase the stock at $125, but do not agree definitely to do so, and the stock is to be deposited with a trust company in the meantime. The lease is to run until 1925. The entire stock of the Company is $3,750,000, divided into shares of $100 each, and it has been selling at $110, and bringing 5 per cent. interest. Under the proposition which has been accepted by the eight largest stockholders they will cease to be stockholders, and simply get their 6 per cent. dividend, no matter how much profit the Company may make. Yet, as seen by their statement, they regard this as a very advantageous offer, as under the present conditions the stock has not been as profitable as it would have been if better service and lower rates could have been given. The trustee which is to hold the stock is the New York Security and Trust Company. The present Company turns over to the new one all of its franchise and rights, except its franchise to exist, and it agrees to continue that franchise and maintain all of its rights as a corporation for the interest of the lessee. Among the indebtedness assumed by the new company is $45,000 owed by the Jefferson City Gas Company to the city of New Orleans; $76,000 bonded indebtedness of the New Orleans Gas Company, and $60,000 floating indebtedness. It agrees to pay $2,500 a year for office expenses of the old Company, and in the first 5 years to expend as much as $350,000 in improvements. There is a clause stipulating that if the lease is canceled the indebtedness paid and the money paid for improvements shall be refunded to the Philadelphia Company. The United States Safe Deposit and Savings Bank of this city is named as local trustee. Among the men interested with Mr. Pearson in the new Company is Mr. Morrill, who is known here as the active man in a new Company which proposed to secure the control of the franchise for supplying the city with water, which has been placed before the city in two several forms."

THE Trenton (N. J.) Gas and Electric Company has been absorbed by an undertaking concern, to be known as the South Jersey Gas, Electric and Traction Company. The other gas properties owned by the Company are those of Camden, Stockton, Merchantville, Moorestown, Mount Holly, Haddonfield, Woodbury and Gloucester. The concern also owns and proposes to operate several electric lighting plants and some street railways. Mr. Frank D. Moses will be the Company's Chief Engineer, and it is thought that important changes will be made in the gas supply of the districts named, through piping reconstruction and consolidations. It is said that a coking gas plant will be erected in the Camden district, but we hope, for the sake of the shareholders, that that report is not true.

MR. I. J. SIMPSON, of Newark, N. J., wants to know if there is any truth in our suggestion of some weeks ago that the Brooklyn Union Gas Company will ultimately be leased to the concern that is to take over the Consolidated Gas Company, of this city. He is respectfully referred to Mr. Henry H. Rogers and the National City Bank.

THE proprietors of the Minneapolis (Minn.) Gas Light Company are receiving quite some commendation for their determination to reduce the net selling rate to $1.20 per 1,000 cubic feet, a concession of 10 cents per 1,000. The reduction is to date from the 1st prox.

A PARTY named John E. Hartridge is said to be anxious to start an opposition gas company in Jacksonville, Fla. He says that he is backed by Northern capitalists, who are anxious to expend $500,000 in the project. The named capitalization would seem sufficient for the accomplishment of Mr. Hartridge's aims. In fact, were the whole truth told considerably less would be enough, without saying anything about the money invested in the existing Company, to cause Jacksonville to be almost as bright at night as it is in the day. It is vastly more than an even chance that the Hartridge gas eggs will not even get as far as the orifice to the incubator.

AT a recent meeting of the Doylestown (Pa.) Gas Company a semi-annual dividend of 2½ per cent. was declared. This rate is 1 per cent. per annum over the prior dividend.

A VERY pleasing affair was the dinner tendered to and enjoyed by Mr. Noyes L. Avery, Vice-President of the Grand Rapids (Mich.) Gas Light Company, on the afternoon of the 11th inst. His hosts were his fellow directors in the Company, and the dinner was served in the guests' room of the Peninsular Club. The occasion was the occurrence of Mr. Avery's 85th birthday, and the veteran was in every sense up to the spirit of the gathering. The correspondent who sent us this notice closes his letter in the remark, "We all like him."

MR. C. B. HURLEY, of Tacoma, Wash., and Mr. C. R. Collins, of Seattle, Wash., have accepted the franchise recently awarded them for the construction and operation of a gas plant in Everett, Wash. The grantees propose to commence construction work forthwith. Good luck to them in their venture; but there should be no element of luck about it, since both are practical gas men.

A VERY severe storm of wind, lightning and rain swept over San Francisco, Cal., the morning of the 14th inst., and the principal sufferer in the damage caused seems to have been the San Francisco Gas and Electric Company. One of its storage holders was upset, whether through the effect of a lightning stroke or from the gusty violence of the gale is not at this time determined, and virtually demolished. Our telegraphic advices are to the effect that there was no explosion, and that the contents of the holder (at the time about 250,000 cubic feet of gas were in the vessel) simply burned away in short order in the nature of a vast flambeau.

A RECEIVER has been named to keep in custody whatever property is now owned by the Federal Gas and Fuel Company, of Columbus, Ohio, which concern has been doing a sort of natural fuel gas business in Columbus for not a very protracted period. The proceedings were instituted in the Common Pleas Court, by Messrs. Elias McClellan Posten and Chas. L. Kurtz, who allege fraud in the broadest sense of the term, as the cause for the proceedings. The preliminaries in the case will be found completely described in the issue of the Columbus *Dispatch* dated the 13th inst.

THE American Bridge Company has the contract to furnish to the Railroad Company of Porto Rico two 133 foot spans for the Mamati river bridge, Porto Rico.

MR. CHARLES B. PAYNE has been elected a Director in the Pawtucket (R. I.) Gas and Electric Company, vice the late Mr. Olney Arnold.

MR. ERASTUS JONES, President of the Spencer (Mass.) Gas Company, announces that on and after Jan. 1, 1901, the selling rate for gas on illuminating account will rule at $1.75 per 1,000 cubic feet.

MR. GEORGE F. MACMUN, JR., has accepted a responsible position with the Pawtucket (R. I.) Gas and Electric Company. He is a son of Mr. Macmun, of the Marlboro (Mass.) Gas Light Company.

MR. A. W. FLETCHER, who for several years acceptably filled the place of Superintendent of the Fort Madison (Ia.) Gas Light Company, resigned that position to assume a similar position in ths service of the Mohawk Gas Company, of Schenectady, N. Y.

THE authorities of Glens Falls, N. Y., have entered into a revised contract for the public lighting of that place for a term of 5 years with the Glens Falls Gas and Electric Light Company. The lighting is to be done mainly by means of arc lamps, of 2,000 candle power nominal, at the very low rate of $78 per arc per year. It is further agreed by the Company that it will supply light to the public buildings free, in a value not to exceed $600 per annum.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO., PROPRIETORS.

MONDAY, DECEMBER 24, 1900.

The Market for Gas Securities.

Better prices prevailed in all classes of goods dealt in on the Stock Exchange during the week, and as the sound advance usually with the ailing, Consolidated moved up about 3 points, the opening in it to-day (Friday) was 191 to 191½, with very little doing. In fact Consolidated transfers for cash have of late been very few. There is nothing of moment to note respecting the local gas situation, but whispering of the loud order is continuous to the suggestion that Brooklyn Union and Consolidated Gas are not very far apart from an amalgamating point of view. If there is point to the idea, Brooklyn Union should be selling for at least the quoted price of Consolidated. The capitalization of every sort of the former is but $30,000,000, and its business is equal to one-fourth that of the latter. The Brooklyn folks may not have relative value in actual property, but as an earner on existing capitalization they can easily hold their own with the combination in control of Consolidated.

Brooklyn Union is quoted to day at 175 to 178. The general gas list is strong. The Westchester (N. Y.) Lighting Company has notified all holders of outstanding 6's and 5's on its various properties that the same will be retired, at the office of the Company, Yonkers, N. Y., on or before Jan 28, 1901.

Gas Stocks.

Quotations by George W. Cleve, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

DECEMBER 24.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,200	100	191	191¼
Central Union, Bonds, 5's.	3,000,000	1,000	103¼	109½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	120	..
Metropolitan Bonds	658,000	..	108	113
Mutual	3,500,000	100	225	250
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	103¼	109
Northern Union, Bonds, 5's.	1,250,000	1,000	104	104¼
New York and East River.. Bonds 1st 5's	3,500,000	1,000	103	108½
" 1st Con. 5's	1,500,000	..	115	.
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	132	150
Preferred	5,000,000	100	150	158
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	175	178
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1	1¼
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	30	40
" 1st Mtg. 5's	503,000	1,000	98½	99½
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7	9
" " Bonds, 5's	5,350,000	1,000	68	71
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati G. & C. Co.	8,500,000	100	194	198
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,780	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	500,000	1,000	103	105
Consumers, Toronto	1,700,000	50	215	216
Consolidated, Baltimore	11,000,000	100	59	59½
Mortgage, 6's	3,000,000	..	..	115
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	12	16
" Con. Mtg. 5's	880,000	1,000	80	85
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95	97
" Prior Lien 5's	4,737,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co..	1,000,000	50	100	105
" 1st Mtg. 5's	1,325,000	1,000	..	..
Hartford	750,000	25	240	280
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	62	70
" Bonds, 6's	2 650,000	..	95½	97½
Jackson Gas Co	250,000	50	70	75
" 1st Mtg. 5's	265,000	1,000	101	103½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	35
Bonds, 1st 5's	2,822,000	1,000	101¼	103
Laclede, St. Louis	8,271,000	100	72	73
Preferred	2,500,000	100	97	100
Bonds	10,000,000	1,000	107	107½
Lafayette Gas Co., Ind	1,000,000	100	40	50
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co	400,000	100	70	75
" 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1901	100,000	25	97	8
Montreal, Canada	2,000,000	100	182	184½
Newark, N. J., Con. Gas Co Bonds, 6's	6,000,000	..	..	55
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co	1,000,000	50	110	..
Oakland, Cal	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	99¾	100
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	30,100,000	1,000	90¾	91
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co	1,500,000	100	47	05
1st Mortgage 6's	650,000	1,000	82	88
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,465,000	1,000	88	90¼
St. Joseph Gas Co	1,000,000	100	81	84
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	9	10
Bonds	1,612 000	1,000	86½	93
Washington, D. C	2,600,000	20	273½	275¼
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
Bonds, 5's	3,330,500	..	107	107½
Wilmington, Del.	600,000	50	200	201

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILA., PA., Dec 12, 1900.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable January 15, 1901, to stockholders of record at the close of business, Dec. 29. Checks will be mailed.

1332-4 LEWIS LILLIE, Treasurer.

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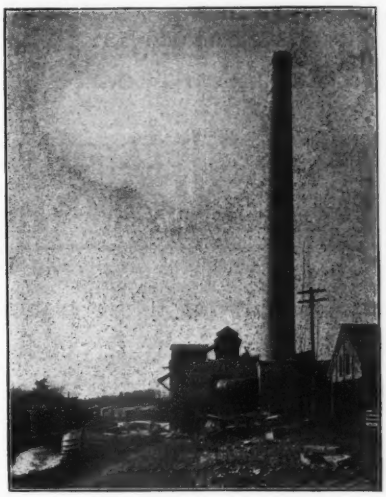

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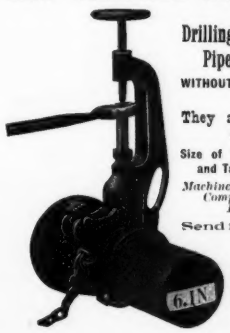

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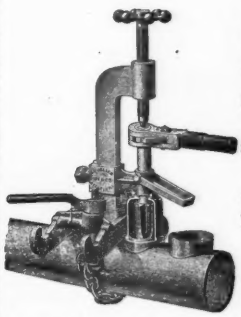

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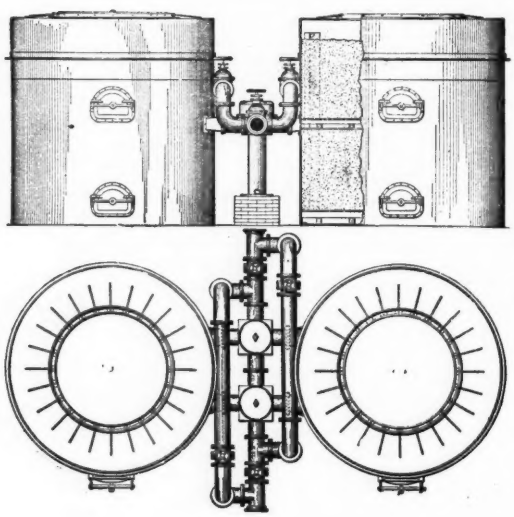

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Birkenhead, England	2,250,000
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Windsor Street Works, Birmingham England (Second Contract)	2,000,000
Halifax, England	1,000,000
Toronto	250,000
Ottawa	250,000
Toronto (Second Contract, Remodeled)	2,000,000
Lindsay (Remodeled)	125,000
Belleville	250,000
Ottawa (Second Contract)	250,000
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Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract)	250,000
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Winnipeg, Man.	500,000
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Gas, Electric Light, Water Works, and Electric Street Railways Built, Remodeled, Operated, Bought and Sold.

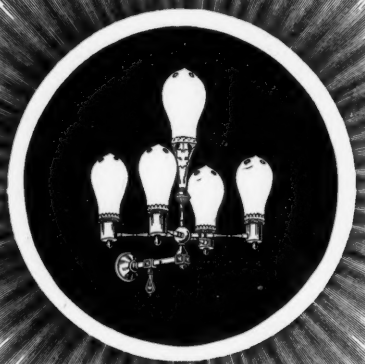
A few of the places where the SUTHERLAND Apparatus is in successful operation:

Ilion, N. Y.
Herkimer, N. Y., 2 orders.
Little Falls, N. Y.
Fishkill-on-Hudson, 2 orders.
Clifton Springs, N.Y., 2 orders.
Green Bay, Wis.
Stevens Point, Wis.
Tarrytown, N.Y., 3 orders.
Ft. Henry, N. Y.
Gainsville, Fla.
Hollidaysburg, Pa.
Waterville, N. Y.
Huntington, L. I.
Lexington, Mo.
Mendota, Ill.
Circleville, O.
Joplin, Mo.
Asheville, N. C.
Youngstown, O.
Kingston & Rondout, N. Y.

CORRESPONDENCE SOLICITED.

KERN

INCANDESCENT GAS LIGHT CO.



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NEW YORK.

KERN INCANDESCENT GAS LIGHT COMPANY'S

SYSTEMS.

SAVES 80 PER CENT. OF YOUR GAS BILL.

THE NEW DISCOVERY.

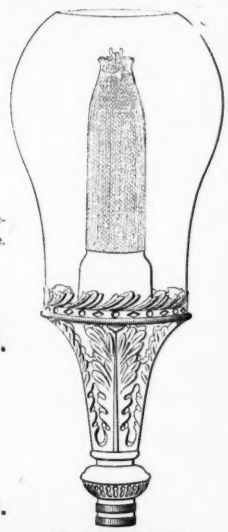
BURNS ONE CUBIC FOOT OF GAS PER HOUR.

No Chimneys to Break. Mantles do not Blacken. Better than Electricity, and only 1-10th the Cost. Not a mere statement, but a Guarantee.

CAN BE USED WITH { MANUFACTURED GAS. NON-CARBURETTED GAS. NATURAL GAS OR GASOLINE GAS.

35 TO 40 CANDLES PER CUBIC FOOT.

Burner No.	0	consumes	8-10	cubic foot,	30-candle	power.
"	1	"	1	"	35	"
"	2	"	2	cubic feet,	70	"
"	3	"	3	"	105	"
"	4	"	4	"	140	"
"	7	"	7	"	225	"



Prices Reasonable. Catalogues on Application. Agents Wanted.

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PURIFIER OR SCRUBBER — FOR LIME OR IRON OXIDE.

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CHURCH'S PATENT, BOLTED OR RIVETED

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Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

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PRESSURE GAUGE.

For continuous records of **Street Gas Pressure.** Simple in construction, accurate in operation, and low in price.

Fully Guaranteed. Send for Circulars.

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Waterbury, Conn.

Silver Medal, Paris Exposition.

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Double and Single Gate Valves, ¼" to 72",

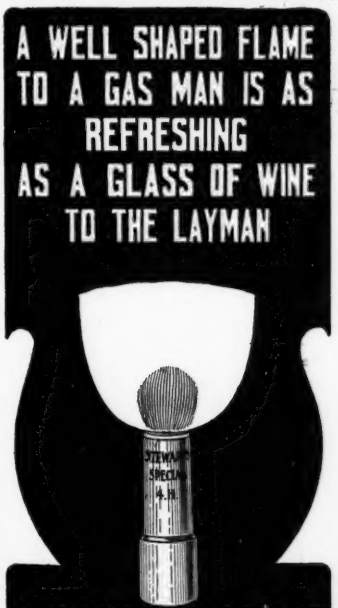
—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

HOT GAS VALVES A SPECIALTY.

Send for Catalogue.

A WELL SHAPED FLAME TO A GAS MAN IS AS REFRESHING AS A GLASS OF WINE TO THE LAYMAN



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ENGINEERS, FOUNDERS, MACHINISTS,
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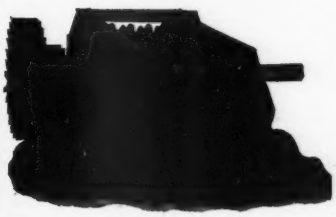

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LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC.

Tilting Coal and Coke Cars, Breaker Rolls, Shaking Screens, Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

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Constructors of Coal Gas Apparatus.

EASTERN AGENTS FOR

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COAL GAS PLANTS AND GAS APPARATUS.

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Coal and Water Gas Plants.

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RECUPERATIVE FURNACES, WASHERS, CONDENSERS, PURIFIERS, PURIFYING MACHINES, COKE CONVEYERS, ETC.

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Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

GAS RETORTS AND SPECIAL BLOCKS AND FIREBRICK MANUFACTURED UNDER THE SUPERINTENDENCE OF MY OWN CHEMIST.

COMPLETE GAS WORKS

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LATEST IMPROVED GAS EXHAUSTER

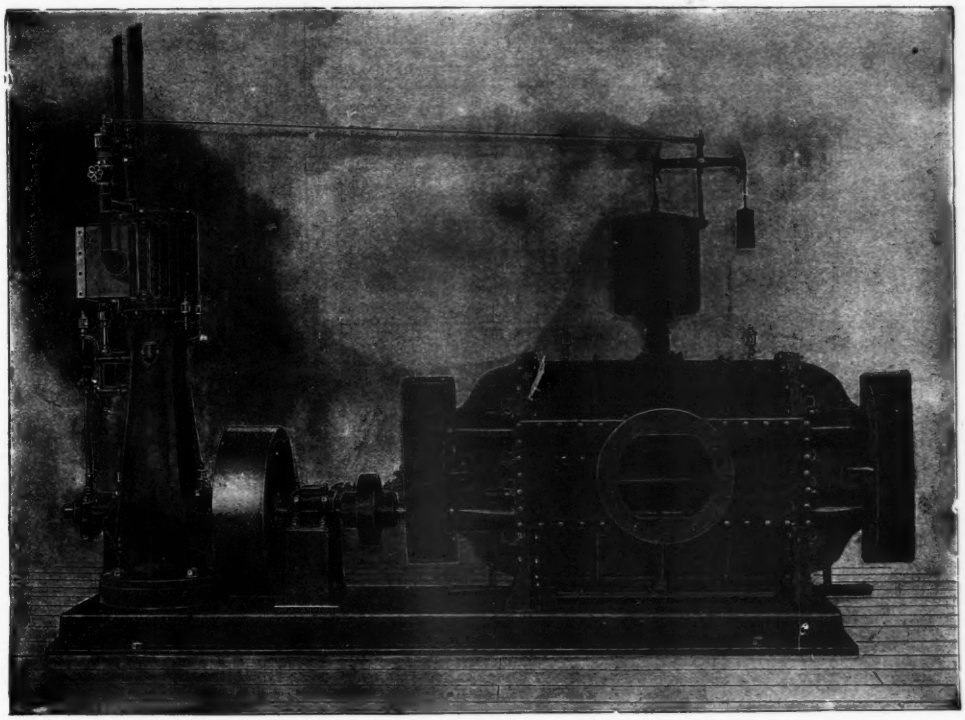
—AND—

NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



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Established 1856. Works at Phillipsburgh, N. J.

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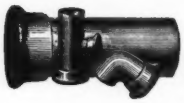

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From Three to Forty-Eight Inches Diameter. Also, all Sizes of

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"Bell" Spigot, Quick, Etc. "Glamorgan" Pipe Fittings

M. J. DRUMMOND & CO.

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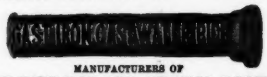

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Also, FLANGE PIPE, LAMP POSTS, Etc.

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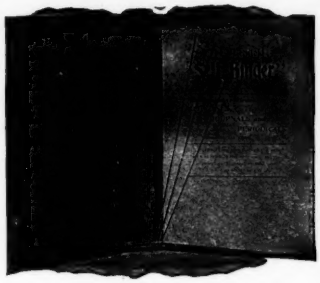

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STORAGE TANKS FOR GAS WORKS,

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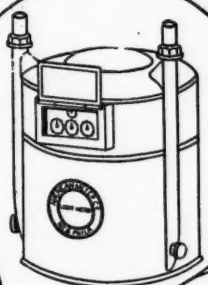

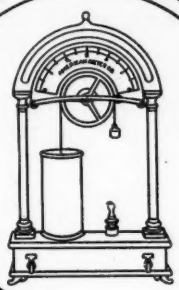

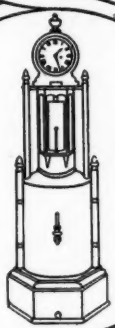

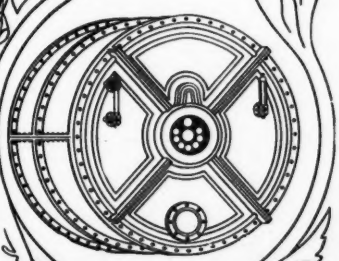

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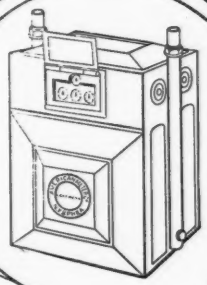
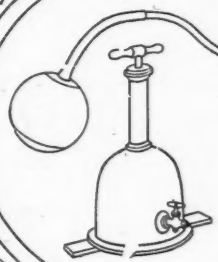
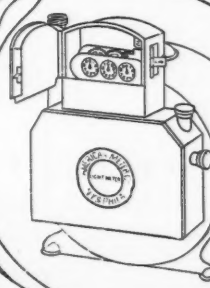






PUBLIC LIGHTING TABLE.

JANUARY, 1901.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	3.50 AM	6.20 AM	4.30	6.30
Wed.	2	4.50	6.20	4.30	6.30
Thu.	3	No L.	No L.	4.30	6.30
Fri.	4	No L. FM	No L.	4.30	6.30
Sat.	5	No L.	No L.	4.30	6.30
Sun.	6	5.20 PM	8.00 PM	4.30	6.30
Mon.	7	5.20	9.00	4.30	6.30
Tue.	8	5.20	10.00	4.40	6.30
Wed.	9	5.20	11.00	4.40	6.30
Thu.	10	5.20	12.00	4.40	6.30
Fri.	11	5.20	12.50 AM	4.40	6.30
Sat.	12	5.20 LQ	1.50	4.40	6.30
Sun.	13	5.30	2.50	4.40	6.30
Mon.	14	5.30	3.40	4.40	6.30
Tue.	15	5.30	4.40	4.50	6.25
Wed.	16	5.30	5.40	4.50	6.25
Thu.	17	5.30	6.20	4.50	6.25
Fri.	18	5.30	6.20	4.50	6.25
Sat.	19	5.30	6.20	4.50	6.25
Sun.	20	5.40 NM	6.20	4.50	6.25
Mon.	21	5.40	6.20	4.50	6.25
Tue.	22	5.40	6.20	5.00	6.25
Wed.	23	5.40	6.20	5.00	6.25
Thu.	24	5.40	6.20	5.00	6.25
Fri.	25	10.20	6.20	5.00	6.25
Sat.	26	11.30 FQ	6.20	5.00	6.25
Sun.	27	12.40 AM	6.10	5.00	6.25
Mon.	28	1.50	6.10	5.00	6.25
Tue.	29	2.50	6.10	5.05	6.15
Wed.	30	3.40	6.10	5.05	6.15
Thu.	31	4.30	6.10	5.05	6.15

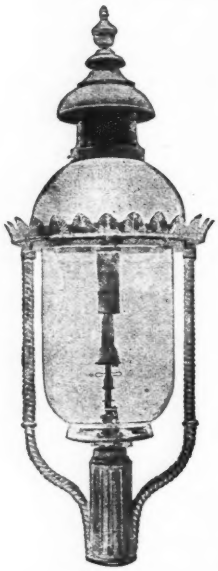
TOTAL HOURS LIGHTING DURING 1901.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.10	January	423.20
February	192.30	February	355.25
March	180.00	March	355.35
April	158.30	April	298.50
May	140.40	May	264.50
June	135.40	June	234.25
July	138.00	July	243.45
August	156.20	August	280.25
September	174.40	September	321.15
October	202.30	October	374.30
November	220.40	November	401.40
December	241.30	December	433.45
Total, yr.	2161.10	Total, yr.	3987.45

NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....



No. 36.

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Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

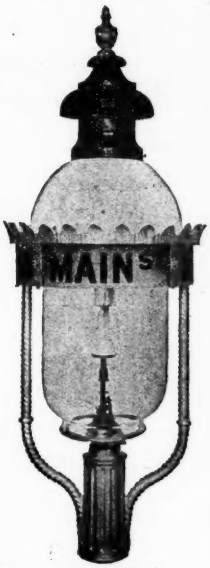
By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



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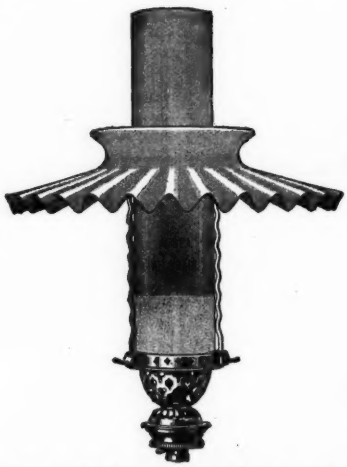
Welsbach Famous Mantles.

THE INCOMPARABLE

"Yusea" Welsbach Mantle

FINEST EXAMPLE OF INCANDESCENT GAS LIGHT EVER EXHIBITED.



OTHER WELSBACH BRANDS —OF— Magnificent Brilliancy —AND— Endurance.

THE HIGHEST ILLUMINATION, The Lowest Cost.

Welsbach Lamps, Mantles, and Complete Line of Glassware and Supplies

WELSBACH COMPANY,

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Chicago Branch Department and Supply House, - - - - - 70 Wabash Avenue.

THE UNITED GAS IMPROVEMENT COMPANY.

THE STANDARD DOUBLE SUPERHEATER LOWE WATER GAS APPARATUS.

CONTRACTS RECEIVED SINCE JANUARY 1, 1900.

	SETS.		SETS.
DANSVILLE, N. Y.	1	MOUNT HOLLY, N. J.	1
WEST CHESTER, PA.	1	SEATTLE, WASH.	1
COHOES, N. Y.	2	TARRYTOWN, N. Y.	1
OGDEN GAS CO., CHICAGO	1	HOBOKEN, N. J.	2
CENTRAL UNION GAS CO., NEW YORK	1	PATERSON, N. J.	2
SPENCER, MASS.	1	NEWARK, N. J.	2
SAN FRANCISCO	1	JERSEY CITY, N. J.	1
BROOKLYN UNION GAS CO., BROOKLYN	1	AUSTIN, TEX.	1
RICHMOND, VA.	2	ELIZABETH, N. J.	1
CAMBRIDGE, MASS.	2	ROCKAWAY BEACH, N. Y.	1
CARBONDALE, PA.	1	NEWTON, N. J.	1
HACKENSACK, N. J.	1	Phœnixville, Pa.	1
TIFFIN, O.	1		

NUMBER OF SETS 31
TOTAL SETS INSTALLED TO JANUARY 1, 1900 327

TOTAL SETS INSTALLED TO DATE 358
TOTAL DAILY CAPACITY . . . . . 227,775,000 Cubic Feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

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CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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Gas House and other Tile.

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FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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The Construction of Gas Works

PRACTICALLY DESCRIBED,

By WALTER RALPH HERRING.

Price $2. For Sale by

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32 Pine Street, N. Y. City.

Adam Weber Sons,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

Works, LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR., CO.,

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Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.

OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 300 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

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Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

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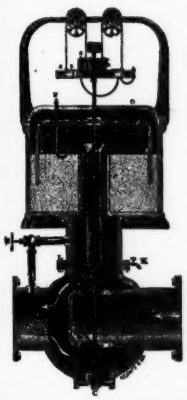

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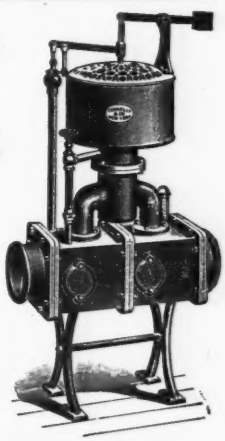

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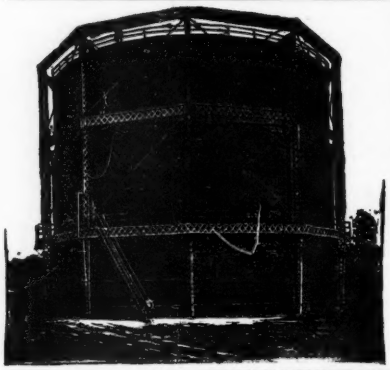

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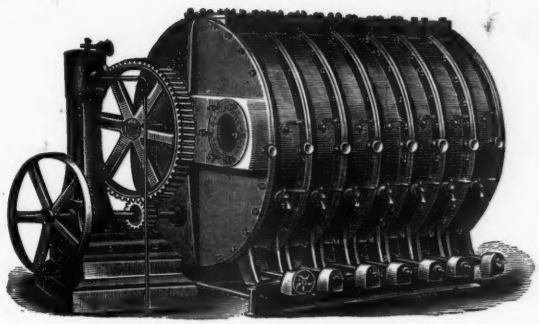

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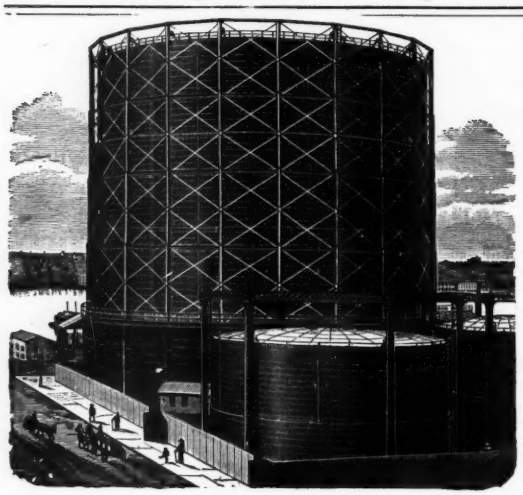

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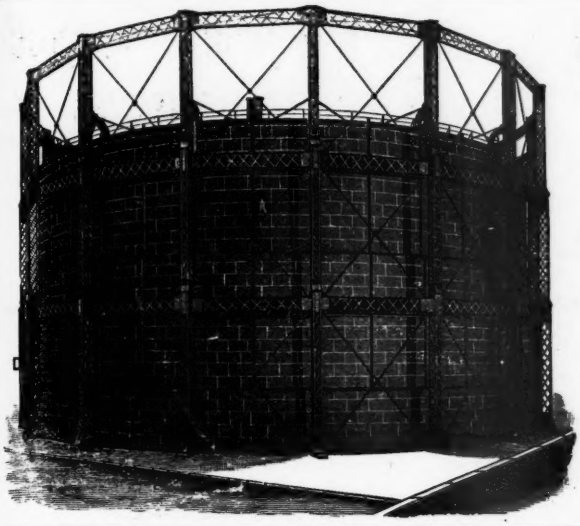

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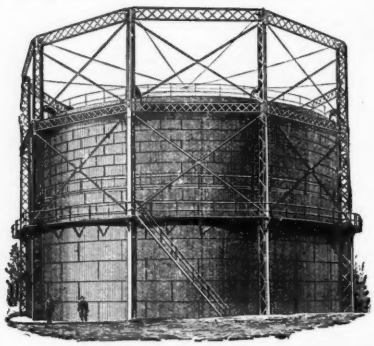

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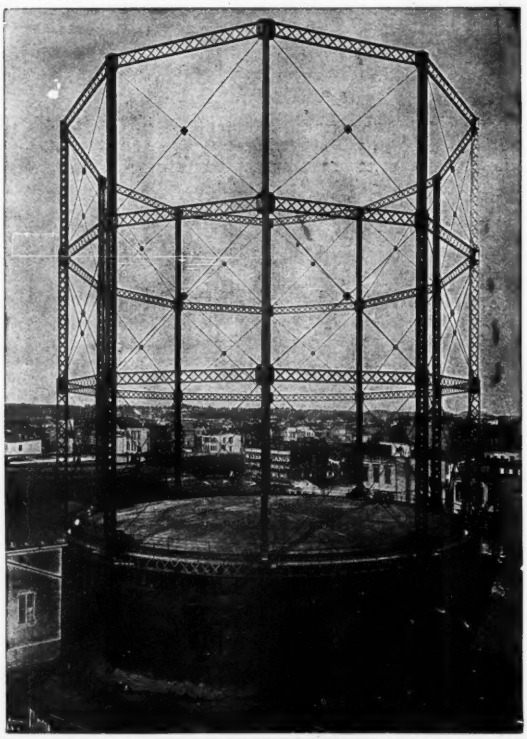

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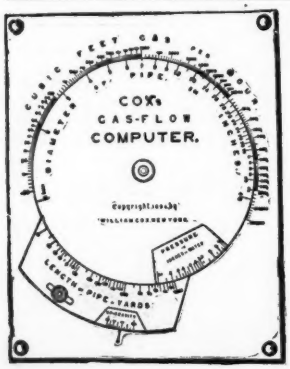

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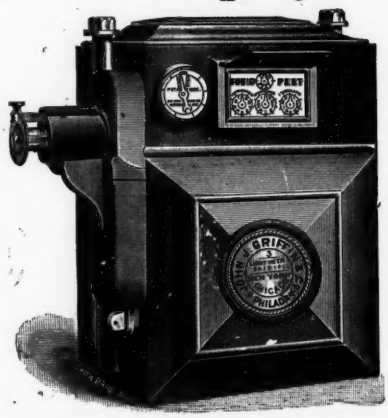

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